



US Army Corps of Engineers, Kansas City District



**TUTTLE CREEK DAM SAFETY ASSURANCE PROGRAM
BIG BLUE RIVER, KANSAS**

FINAL

**EVALUATION REPORT
AND
ENVIRONMENTAL IMPACT STATEMENT**

July 2002

Volume I of VII



FINAL

Environmental Impact Statement Tuttle Creek Dam Safety Assurance Program Big Blue River, Kansas

The responsible lead agency is the Kansas City District, Corps of Engineers. The U.S. Environmental Protection Agency, Region VII is a cooperating agency for this EIS.

Abstract: The Corps as part of an ongoing effort to assess dam safety and performance, as required by Corps' Engineering regulations, has undertaken a Dam Safety Assurance Study of the Tuttle Creek Dam, Big Blue River, Kansas. This study identified deficiencies in the foundation of the existing dam that could lead to failure in the event of a major earthquake. In addition, minor deficiencies were identified in the existing tainter gate system and with the existing amount of freeboard that could adversely affect performance of the dam during a major flood event. Failure of the structure in the event of a major earthquake or flood would have significant adverse impacts on the human environment, including property damage and potential loss of human life. Considering these potential significant impacts on the human environment, and in accordance with the National Environmental Policy Act, the Corps initiated preparation of an Evaluation Report and Environmental Impact Statement (EvR/EIS). This Final EvR/EIS presents a screening level analysis of several alternatives considered during scoping and a detailed analysis of four alternatives that would minimize the potential for loss of human life and property damage related to failure of the dam in the event of a major earthquake. These included: Restricted Lake Operation; Stabilize Foundation Soil with Drawdown; Stabilize Foundation Soil without Drawdown; and Enlarge Embankment. The Final EIS identifies Stabilize Foundation Soil without Drawdown as the Corps' Preferred Alternative. In addition, the Corps considered the "No Action" Alternative. The Corps also identified potential measures to ensure satisfactory performance of the dam during a major flood. These measures include minor repair work on the existing tainter gate system and construction of a "Jersey barrier" wall across the top of the dam to increase freeboard and prevent wind and wave wash. The Final EvR/EIS presents a detailed study of the environmental impacts associated with the five alternatives listed above, the minor measures needed to ensure satisfactory performance of the dam during a major flood, and an interim measure proposed to enhance public safety. In addition, the FEnvR/FEIS contains comments received in response to the Draft EvR/EIS and the Corps' responses. The FEnvR/FEIS is available for public inspection for 30 days from the date of the Environmental Protection Agency formal Notice of Availability.

Note: Information, displays, maps etc. in the Tuttle Creek Dam Safety Assurance Program Evaluation Report and appendixes are incorporated by reference in this EIS.

If you would like further information on this Final EvR/EIS, please contact:
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EXECUTIVE SUMMARY

In accordance with the National Environmental Policy Act (NEPA), the U.S. Army Corps of Engineers (Corps/USACE), Kansas City District has prepared a Final Evaluation Report (FEvR) and Final Environmental Impact Statement (FEIS), dated July 2002, for the Tuttle Creek Dam Safety Assurance Program (TCDSAP), Big Blue River, Kansas. This study considers the environmental impacts of proposed alternatives identified to address seismic issues associated with the Tuttle Creek Dam. In addition, NEPA evaluations of minor measures proposed to address the hydrologic adequacy of the dam are addressed in the FEvR/FEIS. The U.S. Environmental Protection Agency-Region VII is serving as a Cooperating Agency for this study.

Tuttle Creek Lake is located in Riley and Pottawatomie Counties on the Big Blue River just upstream from the City of Manhattan, Kansas. Tuttle Creek Lake was constructed and is operated by the U.S. Army Corps of Engineers, Kansas City District as a multipurpose lake project. The Congressionally authorized project purposes include: recreation; fish and wildlife; navigation; water supply; water quality; and flood control. Tuttle Creek Lake covers approximately 12,500 surface acres at the multipurpose pool elevation of 1,075 feet, mean sea level. The total for the lake and surrounding Corps lands is 33,574 acres.

As part of the Corps' ongoing Dam Safety Assurance Program, the Tuttle Creek dam was evaluated for adequacy considering the anticipated maximum credible earthquake (MCE) and the operating basis earthquake (OBE) that would be expected for the project area. The MCE/OBE for the project area was projected to be a magnitude of 6.6 and 4.9 respectively and would most likely originate from the Humbolt Fault Zone, near Wamego, Kansas. Foundation soil of Tuttle Creek dam would liquefy during these major seismic events. The MCE would result in cracking of the impervious core and failure of the pressure relief well collector system, and within approximately 2-6 hours there would be an uncontrolled release of the pool. While damage to the dam associated with an OBE is less, failure of the pressure relief well collector system and eventually uncontrolled release of the pool would be expected. Although the probability of an earthquake of this magnitude occurring in the Tuttle Creek Lake area is extremely low, Corps regulations require that all dams "are required to survive and remain safe during and following an MCE event". In addition, Corps regulations require that the dam "must be capable of remaining operational with only minor repair during and after an OBE." Corps' regulations further require that "seismic safety of USACE embankment dams, where failure would result in loss of life, must be assured". This FEvR/FEIS describes the existing conditions at Tuttle Creek Lake, potential alternatives that would address the seismic stability issue and their environmental impact.

The Corps' Notice of Intent to prepare an EIS was published in the Federal Register on July 11, 2000. The Corps scoping process was conducted during the spring/summer of 2001 and included meetings with local, state and Federal agencies, organizations and the community. On May 14, 2001, the Corps held a community information/scoping meeting, attended by over 300 members of the community and agency representatives at Manhattan, Kansas to present information on the study and receive input from the community on resources in the affected area, alternatives and potential impacts. Comments were solicited from the community at this initial meeting and accepted through a comment period, which closed on July 1, 2001. The Draft Evaluation Report and Draft Environmental Impact Statement were released to the community on April 16, 2002. A community meeting to receive comments on the DEvR/DEIS was held in Manhattan, Kansas on May 2, 2002 and the comment period closed on June 10, 2002. Comments received in response to the DEvR/DEIS and the Corps responses are included in Section 8 of the FEIS.

Five alternatives have been moved forward for detailed study in the FEIS. These alternatives include: the "No Action" Alternative; Restricted Lake Operation; Stabilize Foundation Soil with Drawdown; Stabilize Foundation Soil without Drawdown; and Enlarge Embankment. The FEvR/FEIS identifies Stabilize Foundation Soil without Drawdown as the Corps' Preferred Alternative. The resources in the project area and potential environmental impacts associated with each of these alternatives are discussed in the FEvR/FEIS. The FEvR/FEIS also discusses the minor measures needed to ensure satisfactory performance of the dam during a major flood, and an interim measure proposed to enhance public safety. Written comments on the FEvR/FEIS can be mailed to U.S. Army Corps of Engineers, 601 E. 12th Street, Kansas City, MO 64106, ATTN: Bill Empson, EC-GD. Comments can also be provided via e-mail at tcdam.nwk@usace.army.mil. The FEvR/FEIS is available for public inspection for 30 days from the date of the Environmental Protection Agency formal Notice of Availability. Copies of the FEvR/FEIS may be requested from the address listed above or viewed on the Tuttle Creek Dam Safety Assurance Program website at <http://www.nwk.usace.army.mil/tcdam>. Copies of the FEvR/FEIS may be viewed on the above listed web page, at local Corps' offices including Tuttle Creek, or at community libraries in the project area. For further information concerning the TCDSAP, the FEvR/FEIS, you should contact William B. Empson, P.E., Project Manager for the Tuttle Creek Dam Safety Assurance Study at the above address or by telephone at 816-983-3556.

FINAL
ENVIRONMENTAL IMPACT STATEMENT

**Tuttle Creek Dam Safety Assurance Program
Big Blue River, Kansas**

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7

8 **1. Introduction**
9

10 **1.1 Project Location**
11

12 Tuttle Creek Lake (Figure 1) is located in Riley and Pottawatomie Counties,
13 Kansas and covers approximately 12,500 surface acres at the multipurpose pool
14 elevation of 1,075 feet, mean sea level (ft., m.s.l.). The dam that forms Tuttle Creek
15 Lake is located on the Big Blue River, 12.3 river miles above its confluence with the
16 Kansas River, near river mile 147, and approximately 6 miles north of the City of
17 Manhattan. The total area occupied by the lake and surrounding Corps lands is
18 33,574 acres.
19

20 **1.2 Project History**
21

22 The Kansas River basin reservoir system, including Tuttle Creek Lake, grew
23 out of several events over the course of many years that demonstrated the need for
24 control of flows on the Kansas River and its tributaries.
25

26 Floods provided the catalyst for change in the way flood control services
27 were delivered for the people of the heartland region. In May of 1935 flooding on
28 the Republican River killed 105 people. As a result, Congress implemented the
29 Flood Control Act of 1936. This was the first Federal measure to address flood
30 reduction in the nation as a whole. The Act authorized construction of levees and
31 flood walls at Lawrence, Topeka, and Kansas City. The Act also authorized studies
32 of additional flood control measures on the Big Blue and Kansas Rivers.
33

34 The studies authorized in 1936 resulted in a general comprehensive plan for
35 flood control in the Missouri River basin that was Congressionally authorized in the
36 Flood Control Act of 1938. This Act included plans for a series of reservoirs in the
37 Kansas River basin, including Tuttle Creek Lake. Tuttle Creek Lake was then
38 incorporated into the Missouri River Development Plan adopted in the Flood Control
39 Act of 1944.
40

41 For years, funds were stricken from appropriation bills on the strength of
42 dissent from Kansas Senators citing strong local opposition to construction of Tuttle
43 Creek dam. As a result of this opposition, beginning in 1946, the Corps of
44 Engineers restudied the Big Blue River basin for other dam sites. The only site that
45 was economically justified was that of the existing Tuttle Creek dam.
46

47 As a result of continuing opposition to the project, the issue was presented to
48 President Truman's Water Resources Policy Commission's committee on river
49 program analysis. While the issue was being considered by the Congress and the
50 committee in early July of 1951, a massive storm caused the Kansas River to crest
51 simultaneously along its entire length resulting in wide spread flooding and disaster.
52

53 In late July of 1951, the Corps of Engineers at the Missouri River States
54 Committee meeting presented a slightly revised version of the 1936 study
55 recommendations. This plan was then forwarded to the Bureau of Budget and
56 Congress where funding was appropriated for construction of the proposed plan,
57 including Tuttle Creek dam. However, strong opposition to the plan continued even
58 with start of construction on Tuttle Creek dam in 1952.
59

60 In 1953 a massive drought set in on the Kansas River basin causing
61 significant crop losses and difficulties with providing water supply thus making the
62 need for water storage during dry periods a major issue for the basin.
63

64 Construction of Tuttle Creek dam continued, storage of water in the lake
65 began in March 1962, and the lake became fully operational for all Congressionally
66 authorized purposes when it reached multipurpose pool in April of 1963.
67

68 **1.3 Purpose and Need**

69

70 Tuttle Creek Dam (Figure 2 and Figure 3) is a rolled earth fill and hydraulic fill
71 embankment, 7,500 feet in length, standing 137 feet high, with a crown width of 50
72 feet and a base width of 1,050 feet. The outlet works consists of twin 20-foot
73 diameter conduits near the right abutment and a separate gated concrete spillway
74 on the left abutment. As noted above, the Corps of Engineers initiated construction
75 of the project in 1952 and closure of the dam was made in July 1959. Storage of
76 water in the reservoir began in March 1962 and the multipurpose pool elevation of
77 1,075.0 ft., m.s.l. was reached in April 1963. Tuttle Creek Lake was constructed
78 and is operated by the U.S. Army Corps of Engineers, Kansas City District as a
79 multipurpose lake project. The Congressionally authorized project purposes
80 include: recreation; fish and wildlife; water supply; water quality; flood control; and
81 supplemental releases for navigation on the Missouri River downstream of Kansas
82 City. The total area occupied by the lake and surrounding Corps lands is 33,574
83 acres.
84

85 During the development of the original design, during construction and
86 throughout the operational life of a dam, the Corps places the highest priority on the
87 commitment to dam safety. Unfortunately throughout history, the failure of poorly
88 designed, constructed or maintained earthen dams has typically resulted in the loss
89 of human life and substantial property damage. The Corps recognizes its
90 responsibility to the community to construct, operate and maintain our dams to the
91 highest safety standards. The Corps standard for community safety is clearly
92 outlined in the following excerpts from our Engineering Regulations, ER 1110-8-
93 2(FR), "Inflow Design Floods for Dams and Reservoirs" dated March 1, 1991, which
94 states:

95
96 "It is the Corps of Engineers policy that dams designed,
97 constructed, or operated by the Corps will not create a threat of
98 loss of life or inordinate property damage. Departures from
99 accepted policy or practice will not be made in the design of a dam
100 simply to reduce cost. Every phase of the planning, design,
101 construction, and operation of a dam will be accomplished to
102 assure that it is safe, efficient, and reliable."

103
104 "When a dam impounds water upstream from a populated area, a
105 distinct hazard to that area from possible failure of the dam is
106 created. This requires that extreme care be exercised in every
107 phase of the engineering design, construction, and operation of the
108 project to assure complete safety. Deliberately accepting a
109 recognizable risk to life in the design of a dam simply to reduce the
110 cost of the structure has been generally discredited from an ethical
111 and public welfare standpoint. Legal and financial capability to
112 compensate for economic losses associated with dam failure is
113 inadequate justification for accepting such a risk, when hazard to
114 life is involved."

115
116 And finally, "A large earthen embankment can be cited as the upper
117 end of the scale insofar as avoidance of risk is concerned. For
118 such a structure, a design should be established on the basis that
119 the possible loss of life is obviously unacceptable and that potential
120 damages could approach disaster proportions; and, therefore,
121 failure cannot be tolerated."

122
123 As part of the Corps' ongoing Dam Safety Assurance Program, the Tuttle
124 Creek dam was evaluated for adequacy under anticipated seismic loading as
125 required by Corps' dam safety regulations, ER 1110-2-1155. Corps' dam safety
126 regulations state that all dams "are required to survive and remain safe during and
127 following the maximum credible earthquake (MCE) event." These regulations
128 further require that the dam "must also be capable of remaining operational with
129 only minor repairs during and after an operating base earthquake (OBE). Finally, it
130 is Corps policy that "seismic safety of USACE embankment dams, where failure
131 would result in loss of life, must be assured."

132
133 Based on historical information, and as detailed analysis in the FEvR more
134 fully describes, the MCE for the project area was determined to be 6.6 magnitude
135 on the Richter scale. An earthquake of this magnitude would most likely originate
136 from the Humboldt Fault Zone (Figure 2.1 of the FEvR), approximately 12 miles
137 east of the dam, near Wamego, Kansas. The OBE was determined as a seismic
138 event capable to induce a peak ground acceleration of 0.03g at the site. If
139 generated by the Humboldt fault, such an event would correspond to a Richter
140 magnitude of 4.9. The MCE has a probability of occurrence of approximately once
141 in 3,000 years. The OBE, by definition, is a 144-year return period event (it has a
142 50% probability of exceedence during the service life of the structure, normally

taken as 100 years). The Evaluation Report also defines the threshold event as the lowest intensity earthquake capable to induce liquefaction of the sand in the unloaded ground near the dam. This threshold earthquake is a 5.7 Richter magnitude event, if generated at the Humboldt fault, and has an estimated return period of approximately once in 1,800 years.

The Potential Scenario for Seismic Related Dam Failure at Tuttle Creek

The most likely scenario for a potential seismic related dam failure at Tuttle Creek would involve the lake at the multipurpose pool elevation of 1,075.0 ft., m.s.l. and a major seismic event ranging from the projected threshold seismic event of 5.7 to the MCE of 6.6 on the Richter scale originating from the Humbolt Fault Zone approximately 12 miles east of the dam near Wamego, Kansas. This level of seismic activity would result in liquefaction of the foundation soil, failure of the pressure relief system, and slumping. In the most extreme case of the MCE, the crest of the dam would drop approximately 30 feet. Considering the multipurpose pool elevation, this would not result in immediate overtopping of the dam. The existing pressure relief system, which currently collects and safely evacuates water that flows beneath the dam, would be seriously damaged as a result of the slumping embankment. (The pressure relief system should not be confused with the outlet works, the twin 20-foot-diameter conduits through which normal releases are made, and which were determined to be capable of surviving a major seismic event.) The amount of damage would be most severe for the MCE but even at the lower level associated with the threshold event, partial failure of the pressure relief system would be expected. Once the pressure relief system fails, unregulated water would begin moving through the foundation of the dam, eroding it, and eventually resulting in dam settlement, overtopping, severe erosion, and uncontrolled release of the pool. In addition, the greater the seismic event, the more likely that there would be vertical and horizontal cracking of the impervious core which would allow additional water to begin moving through the dam, eroding the earthen dam embankment as it passed through the structure. The MCE would produce substantial cracking of the impervious core. For the MCE, within 2-6 hours, this erosion of the dam embankment would result in a complete breach of the Tuttle Creek dam and uncontrolled release of the Tuttle Creek pool. Downstream areas that would be inundated as a result of a seismic related dam failure and uncontrolled release of the Tuttle Creek pool are shown in Plate Nos. 1 through 12 in the Final Evaluation Report.

In summary, based on this initial evaluation, it was determined that the foundation soil of Tuttle Creek dam would liquefy during an MCE and that within approximately 2-6 hours there would be an uncontrolled release of the Tuttle Creek pool. Although slumping of the embankment would be less severe, even for the threshold seismic event, the pressure relief system would be severely damaged, eventually leading to piping and failure of the dam. The Tuttle Creek pool would most likely be at multipurpose pool elevation of 1,075 ft., m.s.l., should this event occur and impacts were considered based on this pool level. This uncontrolled release of the Tuttle Creek pool would have significant adverse impacts on human life, property and other resources downstream of the project at Manhattan, Kansas

191 and downstream on the Kansas River floodplain. In addition, this event would have
192 significant adverse impacts on the capability of the project to continue to fulfill the
193 existing Congressionally authorized project purposes associated with Tuttle Creek
194 Lake, including completely losing the existing capability for flood control, water
195 supply, water quality and navigation, and serious adverse impacts to fish and
196 wildlife and recreation resources. Collectively these losses would also result in
197 significant adverse economic impacts. The nature of damages associated with a
198 dam failure is described in detail in Section 7-03 of the FEvR. The Final Evaluation
199 Report and Final Environmental Impact Statement describe the existing conditions
200 at Tuttle Creek Lake, potential ways to address the seismic stability issue,
201 alternatives that minimize the potential loss of human life and property damage, and
202 their environmental impact. Corps dam safety regulations require that dams be
203 evaluated for performance under seismic loading and establish performance criteria
204 that must be met. The Corps has determined that currently Tuttle Creek dam does
205 not meet the required performance criteria for anticipated seismic events. The
206 purpose of this study is to determine an environmentally acceptable alternative that
207 will adequately minimize the threat to downstream resources should a seismic event
208 in the range from the threshold event to the MCE occur.

209
210 When evaluating the impacts and alternatives available to address the risks
211 to Tuttle Creek Dam due to earthquakes as discussed above, it is important to
212 consider how the impacts of the earthquake on structures and facilities other than
213 the dam might affect response efforts.

214
215 The following discussion is intended to put the threat that an earthquake
216 poses to Tuttle Creek Dam in the context of the other events and impacts that could
217 occur in the Manhattan area during and following a moderate to severe earthquake.
218 These events would be likely to be occurring at the same time that the integrity of
219 the dam is being assessed and potential evacuations ordered. This discussion is
220 not intended to specifically evaluate individual buildings or facilities and should not
221 be considered an evaluation of the available emergency services.

222
223 There will be no warning prior to the earthquake. The occurrence of a large
224 earthquake in the Manhattan area would be likely to result in damages, disruptions,
225 casualties, and injuries on a scale never experienced in the region. The immediate
226 emergency and long-term relief and recovery efforts will tax the resources of the
227 entire Midwest. Unprecedented problems and challenges will be encountered as
228 the Federal government mobilizes resources to augment State and local response
229 efforts.

230
231 A winter event would cause a significant change in response requirements or
232 procedures since heating would become an issue and the decreased ability to reach
233 damaged areas due to the potential for the presence of snow or ice. A summer
234 event could result in difficulties throughout the area due to the loss of electrical
235 power and water to maintain air conditioning systems to cool electronic
236 communication and monitoring equipment.

239 Large areas of the Big Blue and Kansas River valleys will be prone to
240 landslides into the river channel, ground collapse and the damaging effects of
241 liquefaction (a process in which loose soil liquefies during intense shaking). Much of
242 the public infrastructure within the affected areas will be damaged. Immediately
243 following a large earthquake, State and local response efforts would be likely to be
244 overwhelmed.

245 The condition of transportation systems will be critical to the expedient
246 evacuation. Access to and from the river valleys is likely to be limited. Damage to
247 major highways and secondary road systems will occur. Damage to the roadways
248 in the river valleys would be likely to occur due to liquefaction of the soil beneath the
249 roads. Damage to all types of bridges would be expected since the design of
250 bridges in the area does not consider earthquake impacts. Damaged bridges would
251 require inspection and repair before use. In general, ground transportation would
252 likely be seriously disrupted in the river valleys. Airport runways airstrips may
253 experience ground deformation; control towers, other airport structures and facilities
254 will suffer damage. The railway system will most likely be damaged to the point of
255 being unusable since much of the rail lines lie in the Kansas River valley. Gas
256 pipelines, propane tanks, and fuel storage facilities in the area are likely to be
257 damaged and immediately cause fires and interruption of services. Numerous
258 collateral threats will also occur: total or partial collapse of buildings (especially
259 older un-reinforced buildings; mobile homes overturned or knocked from their
260 foundations; fires and limited fire fighting ability due to loss of water supply and
261 pressure; release of hazardous substances or gases at facilities where they are
262 stored or used; damage to critical pipelines through the area; land and mud slides;
263 widespread property and agricultural damage; damage to the Manhattan levee
264 structure; interruption of water supply due to damage to water wells, supply lines,
265 pumping facilities and treatment facilities; rupture of sewage lines and breakdown of
266 sewage disposal systems; downed trees, overhead lines and general loss of public
267 utilities (electric power, natural gas, telephones, etc.); overwhelmed cellular
268 communications systems; damage to government and educational facilities; limited
269 medical care due to overwhelmed facilities and potential damage to the care
270 facilities themselves. disruption of industry and employment, food supply, retail
271 trade, and shortage of supplies/equipment aggravated by speculation and hoarding.
272 Loss of communications (radio, television, telephones, computers, etc.) will create
273 severe impediments to response.

274
275 In addition to damage to Tuttle Creek Dam, the Corps project office may be
276 subject to damage and require immediate assessment. Fort Riley may also be
277 impacted, thus, limiting a military support response.

278
279 Again, it must be noted that the above discussion is intended to put the
280 potential for damage to Tuttle Creek Dam in the context of the other events that
281 would most likely be occurring at the same time that the dam is being evaluated.
282
283
284
285

286 These events are important to consider when evaluating the available options for
287 addressing the threat to the dam. This discussion is not intended to frighten or
288 intimidate, but simply to assist all of those involved in understanding that damage to
289 the dam would be occurring within a framework of many other significant impacts.

290 291 **Other Considerations**

292
293 As part of the Dam Safety Assurance Study, the Corps has completed an
294 evaluation of the hydrologic adequacy of the Tuttle Creek Dam. This evaluation
295 considers whether the dam would perform as expected during the probable
296 maximum flood (PMF). To visualize how big the PMF would be, consider that
297 approximately 60,000 cubic feet per second (cfs) of water was flowing through the
298 tainter gate system at the peak discharge during the 1993 Flood, and that
299 approximately 600,000 cfs, or approximately ten times the 1993 discharge, would
300 be flowing through the tainter gate system during the PMF. The probable
301 occurrence of the PMF is extremely low. The first step in this part of the evaluation,
302 as fully described in the Evaluation Report, was defining the PMF using the most up
303 to date methods. This evaluation resulted in a determination that the PMF would
304 result in a slightly higher pool elevation than was originally determined. Corps dam
305 safety regulations set standards for levels of protection that would result in
306 satisfactory performance of the dam for the PMF. In order to maintain the required
307 level of dam safety, the Corps has determined that a minor modification to the dam
308 would be required. These modifications include measures to increase the available
309 freeboard in order to prevent wind and wave wash over the top of the dam for the
310 PMF and minor improvements to the existing tainter gate system. A discussion of
311 the hydrologic adequacy evaluation, proposed measures to increase available
312 freeboard, and proposed repairs to the existing tainter gate system are included in
313 Section 6.

314 315 **Purpose of the Study**

316
317 When Tuttle Creek Dam was originally designed and constructed, it was
318 designed to remain fully operational after experiencing a major seismic event or
319 probable maximum flood based on information available at that time. Since the
320 original design, new technology and methods of analysis have been developed that
321 provide better information on potential seismic and major flood events, how these
322 events could affect the existing structure, and how to modify the existing structure to
323 fulfill the original design criteria. The overall purpose of this study, as part of the
324 Corps' ongoing Dam Safety Assurance Program, is to identify alternatives that
325 would minimize to the greatest extent practicable the potential loss of human life
326 should Tuttle Creek Dam experience a major seismic event or probable maximum
327 flood. Tuttle Creek Lake is Congressionally authorized for flood control, water
328 supply, water quality, fish & wildlife, recreation and navigation support. Identifying
329 alternatives that continue to provide the existing level of benefit for each of these
330 authorized project purposes was a high priority during the initial screening process.
331 Comments received during the scoping process also indicated strong community
332 and agency support for maintaining the existing level of benefits for each of these
333 Congressionally authorized project purposes. The Corps has determined that any

alternative that affects the current Congressionally authorized purposes, by diminishing or eliminating these existing benefits, must have strong support from the community and State in order to secure the necessary approval from Congress.

1.4 Authority

The construction of Tuttle Creek Dam and Lake, which is one unit in the general comprehensive plan for flood control and other purposes in the Missouri River Basin, was authorized by the Flood Control Act approved June 28, 1938 (Public Law 761, Seventy-fifth Congress, first session) as modified by the Flood Control Act approved August 18, 1941 (Public Law 228, Seventy-seventh Congress, first session) and expanded by the Flood Control Act approved December 22, 1944 [Public Law 534, Seventy-eighth Congress, second session (House Document No. 475 and Senate Documents Nos. 191 and 247, Seventy-eighth Congress, second session)].

This study is being conducted under the authority of Section 1203 of the Water Resources Development Act of 1986 (P.L. 99-662). One of the alternatives being considered in this study, Restricted Lake Operation, would require a reallocation of the project and therefore Congressional approval. Should this alternative be selected, authority would have to be secured from Congress prior to implementing the alternative.

1.5 Prior Studies

The following studies were completed as part of the Dam Safety Assurance Program for Tuttle Creek Lake: Tuttle Creek Lake - Reconnaissance Report for Dam Safety Assurance Program, Seismic Analysis, May 1992; Tuttle Creek Lake - Dam Safety Assurance Program; Initial Evaluation Report, July 1996; Tuttle Creek Lake - Dam Safety Assurance Program. Phase I Special Study Report, Part I Seismologic Investigation and Embankment Seismic Stability, September 1998; Tuttle Creek Lake - Dam Safety Assurance Program. Phase I Special Study Report, Part II Preliminary Seismic Evaluation of the Outlet Works Structures, 15 December 1998.

1.6 Community Involvement/Scoping

The Corps' Notice of Intent (NOI) to prepare an Environmental Impact Statement, included in Appendix A, was published in the Federal Register on July 11, 2000. The Corps, in accordance with NEPA, has actively solicited input on the project. The Corps scoping process was conducted during the spring/summer of 2001 and included meetings with local, state and Federal agencies, organizations and the community. On April 3, 2001, the Corps held a meeting at Manhattan, Kansas with over 200 representatives of local, state and Federal agencies to present information on the project and receive input from the agencies in preparation for the Corps initial community meeting. On May 14, 2001, the Corps held a community information/scoping meeting, attended by over 300 members of the community and agency representatives, at Manhattan, Kansas to present

information on the study and receive input from the community on resources in the affected area, alternatives and potential impacts. Comments were solicited from the community and agencies at this initial community information/scoping meeting and accepted through a comment period, which closed on July 1, 2001. Comments received at the May 14, 2001 community meeting in Manhattan, Kansas, and during the initial project comment period, May 14, 2001 – July 1, 2001, are included in Appendix A. Included with these comments are the Corps' responses. The Draft Evaluation Report and Draft Environmental Impact Statement were released to the community on April 16, 2002. A community meeting to receive comments on the DEvR/DEIS was held in Manhattan, Kansas on May 2, 2002 and the comment period closed on June 10, 2002. A summary of comments and responses on the DEvR/DEIS is included as Section 8 of this report. Copies of the actual written comments received on the DEvR/DEIS are included in Appendix J of the FEIS.

In addition, the Corps has established a website to provide information on the project, <http://www.nwk.usace.army.mil/tcdam>. All material contained on the Tuttle Creek Dam Safety Assurance Program website is included in Appendix A. As of July 15, 2002, this website has had approximately 2,700 visitors. A list of agencies and organizations that have been contacted and invited to comment on the study is included in Section 10. List of Agencies and Organizations /Libraries/Corps Offices/Website.

After reviewing the comments received in response to the DEvR/DEIS, the Corps addressed comments on the DEvR/DEIS, made appropriate revisions and prepared the Final Evaluation Report and Final Environmental Impact Statement (FEvR/FEIS).

Running concurrently with the review of the DEvR/DEIS was the Section 404 of the Clean Water Act (33 USC 1344) Public Notice. The Public Notice and draft Clean Water Act compliance review documents are included in Appendix G of this document.

Finally, this Final Evaluation Report and Final Environmental Impact Statement was released in August of 2002 for the community and agencies to inspect the FEvR/FEIS and the Corps' responses to comments received on the DEvR/DEIS. The reports will be available for 30 days after the Notice of Availability appears in the Federal Register. After this 30-day period, provided that no outstanding unresolved issues remain, the Corps would then prepare a Record of Decision. The point of contact for this project is Bill Empson, U.S. Army Corps of Engineers, Kansas City District, 700 Federal Building, 601 E. 12th Street, Kansas City, MO 64106. In addition, correspondence can be provided via electronic mail at tcdam.nwk@usace.army.mil. The reports can be viewed on the Corps' Tuttle Creek Dam Safety Assurance Study website at, <http://www.nwk.usace.army.mil/tcdam>. Copies of the FEvR/FEIS may be requested from the address listed above, and/or viewed on the above listed website or at the community libraries and Corps' offices listed in Section 10.

1.7 Cooperating Agency

The U.S. Environmental Protection Agency (EPA) – Region VII is serving as a Cooperating Agency for preparation of this Environmental Impact Statement. A copy of the Cooperating Agency Agreement between the Corps and EPA is included in Appendix A. In their role as a Cooperating Agency, EPA has agreed to provide input concerning their areas of expertise in water quality, drinking water, aquatic resources, appropriate mitigation, and applications that facilitate compliance with the National Environmental Policy Act. In addition, EPA has provided input concerning regulatory, jurisdictional or programmatic requirements of their agency including Section 404 of the Clean Water Act and Section 309 of the Clean Air Act.

1.8 Project Sponsor

Construction of Tuttle Creek Dam was completed in 1962. There were no project sponsors for any project purpose at the time the dam was constructed. In the 1980's, the State of Kansas, represented by the Kansas Water Office, expressed interest in purchasing water supply storage space in several reservoirs in the State of Kansas, including Tuttle Creek Lake. The State and the Corps signed a Memorandum of Understanding (MOU) in 1985 to establish a cooperative partnership between the State of Kansas and the Department of Army to achieve a better level of benefits for the water released from reservoirs in Kansas.

One of the tasks agreed to in the MOU was completion of a water supply reallocation study for Tuttle Creek Lake. The Chief of Engineers approved the Reallocation of Storage Report for Tuttle Creek Lake on August 9, 1989. The report recommended reallocation of 50,000 acre-feet of storage space in Tuttle Creek Lake for water supply.

The State of Kansas, represented by the Kansas Water Office, has entered into three separate water supply storage contracts with the Government for use of a total of 50,000 acre-feet of storage space in Tuttle Creek Lake; Contract No. DACW41-90-C-0042 for 27,500 acre-feet, Contract No. DACW-41-94-L-0002 for 8,650 acre-feet, and Contract No. DACW41-41-96-L-0002 for 13,850 acre-feet.

The State of Kansas Department of Wildlife and Parks operates some of the recreation areas at Tuttle Creek Lake under the terms of a lease agreement. There is no cost-share agreement or contract with KDWP, as recreation at Tuttle Creek Lake was planned and constructed before recreation cost sharing was required.

At Tuttle Creek Lake, there are no non-Federal sponsors for any project purpose that requires a Project Cooperation Agreement to implement cost sharing for the Tuttle Creek Dam Safety Assurance Program study or potential modifications. However, the existing water supply contracts do require that the State of Kansas, represented by the Kansas Water Office, reimburse a portion of the cost of any dam safety modification.

The existing water supply storage contracts with the State of Kansas, represented by the Kansas Water Office, all contain contract language that addresses the State's share of the cost of a Dam Safety Assurance Program modification. The total cost to the State of Kansas, represented by the Kansas Water Office, would be 0.3735 percent of the total Dam Safety Assurance Program Construction General funding implementation and/or construction costs.

1.9 Study Area

The study area (Figure 3) for direct impacts described in the Tuttle Creek Dam Safety Assurance Study EIS includes areas upstream of Tuttle Creek dam, including Tuttle Creek Lake and surrounding lands, the Tuttle Creek dam, areas downstream of Tuttle Creek dam including the Big Blue River and Kansas River and their floodplains. This includes lands along the Kansas River in: Riley, Pottawatomie, Wabaunsee, Shawnee, Jefferson, Douglas, Leavenworth, Johnson and Wyandotte Counties, Kansas. Some cities/towns within the study area include: the cities of Manhattan, Wabaunsee, St. George, Wamego, Willard, Topeka, Lawrence, Lecompton, Eudora and others. The study area for navigation, economic, secondary and cumulative impacts is much broader and includes the State of Kansas, the Kansas River basin and the lower Missouri and Mississippi River basins.

1.10 Interim Measures

The Corps as part of this study has examined what, if any, interim measures should be put into practice to ensure public safety until such time as an alternative that meets the project purpose and need can be implemented. For each Corps dam there is an Emergency Action Plan (EAP) in place that outlines the measures that Corps personnel are to take in the event of an emergency at the project. These plans are coordinated with state and federal emergency management agencies, local governments, law enforcement agencies, and media in the project area. The Corps' Tuttle Creek Lake EAP was revised and is dated January 2000. The effectiveness of the existing flood warning system and evacuation plan is described in detail in Section 7 below. The Corps as part of this Dam Safety Assurance Study has coordinated closely with the same entities that we worked with on the Tuttle Creek Lake EAP to make them aware of information we were developing during the seismic study and potential risks that would be associated with a major earthquake. The probability is extremely remote that Tuttle Creek dam will ever experience a major seismic event during its projected life. The primary goal of any interim measure would be to minimize the potential loss of human life by maximizing the warning time before dam failure and uncontrolled release of the pool.

The Corps believes that this study has heightened the community's awareness concerning the potential results of seismic related dam failure at Tuttle Creek Lake. This heightened awareness would hopefully minimize the potential for

loss of human life associated with a major seismic event in the Tuttle Creek Lake area. The Corps believes that any interim measure must further ensure public safety beyond what can be achieved through the existing EAP, it must be able to be quickly implemented (i.e. it should not take five years to design and construct) and it must have minimal environmental impact. Considering these factors the Corps identified a Dam Failure Warning System and Evacuation Plan as the most practicable interim measure for improving dam safety until such time as this study can be completed and an alternative selected and implemented. The Corps proposes to implement the Dam Failure Warning System and Evacuation Plan as soon as funding is available. As part of this interim measure the Corps will coordinate with state and federal emergency management agencies, local governments, law enforcement agencies, and media in the project area to develop an evacuation plan that specifically addresses a seismic related dam failure. A complete discussion of the proposed Dam Failure Warning System and Evacuation Plan is included in Section 7.

2. Alternatives

Prior to and throughout the scoping process, the Corps has attempted to identify as broad of range of project alternatives as possible. Section 7-05 of the FEvR contains additional description of alternatives. These alternatives include:

2.1 Alternatives Originally Studied But Removed From Further Consideration In This EIS

2.1.1 Foundation Seepage Cutoff (B.1 in FEvR)

The type of soil in the foundation of the dam and the presence of water in that soil facilitate liquefaction of the foundation soil during a major seismic event. This water that normally moves through the foundation soil is collected in the foundation relief wells and moved through a series of pipes to the pressure relief well collector ditch on the downstream side of the dam. Collection of this water in the relief wells and movement through the pipes prevents internal erosion of the foundation. Deformation of the embankment during a major seismic event would damage the pressure relief well collector system resulting in uncontrolled movement of water through the pervious layers of foundation, erosion of the foundation material and ultimately sudden settlement, overtopping, failure of the dam and uncontrolled release of the pool. One structural engineering treatment that was identified to control seepage and eliminate the necessity of the pressure relief system along the downstream toe was the construction of a cement wall that extends to bedrock beneath the dam to stop normal seepage through the sand beneath the dam. This wall would be constructed by jet grouting. While improving the seepage control by constructing this wall alone would not prevent failure of the dam during a major seismic event, this measure was identified as a critical element for inclusion in both the structural engineering alternatives moved forward for consideration in the FEvR/FEIS.

2.1.2 Enhanced Underseepage Control (B.2 in FEvR)

The Corps evaluated measures to improve the existing relief well collector system by adding 15 reinforced relief wells to the existing system or by constructing additional relief wells with pumps. Fifteen new reinforced relief wells would be needed to prevent piping if the MCE occurred at multi-purpose pool elevation. Using pumped wells would require the construction of a new 13 well system, 600 feet downstream of the toe in order to avoid damage from a major earthquake. The new wells would have no role during normal operation. If a major earthquake occurred and some of the existing relief wells failed, the pumping system would be activated to assume the function of the damaged wells. This system would require the installation and long-term maintenance of submersible pumps and generators that would only be used in the event of a major earthquake. These measures were not moved forward for detailed analysis because they provide only a partial correction, as both would still allow partial failure of the dam.

2.1.3 Enhanced Emergency Action Planning (B.3 in FEvR)

The Corps considered improving the current Emergency Action Plan (EAP). Improving the EAP alone would not meet the requirements of the Corps' Dam Safety Regulations and would not prevent the potential loss of human life and property. While the lake could continue to be operated in accordance with the Congressionally authorized project purposes, should a major seismic event occur, extensive damage to downstream areas would occur as a result of the uncontrolled release of the Tuttle Creek pool. Benefits associated with authorized project purposes would be lost until such time as the dam could be restored and the lake returned to the multipurpose pool elevation. While the Corps determined that Enhanced Emergency Action Planning alone would not meet the purpose and need of the project, the Corps identified a dam failure warning system as the most practicable interim measure for improving dam safety until such time as this study can be completed and an alternative selected and implemented. The Corps proposes to implement the dam failure warning system measures as soon as funding is available. A complete description of the proposed interim measure is included in Section 7. Dam Failure Warning System and Evacuation Plan, below.

The Corps as part of the Enhanced Emergency Action Planning alternative also investigated what measures could be used to manage the floodplain in the affected area to achieve the project purpose. This would involve non-structural measures to minimize and prevent loss of life and property in the downstream area impacted by a potential release of the lake due to earthquake damage to the dam. Plate Nos. 1 through 12 in the FEvR show the potentially impacted areas under consideration. These measures would not involve modifications to the dam or changes to management of the lake in any way.

The total population, properties, and property values potentially impacted by the release of Tuttle Creek Lake are discussed in Section 7-03 of the FEvR. However, the persons and structures most immediately impacted by the loss of Tuttle Creek Dam would be those between the dam and the Kansas River. The

residential population in the potentially impacted area between the dam and the Kansas River is approximately 11,000 people in approximately 5,200 residential structures with a total value of approximately \$108 million. Commercial and industrial properties within the impacted area include facilities with values totaling approximately \$740 million. These properties include critical facilities and infrastructure including water supply, water treatment, schools, day cares, industrial business parks, emergency services, county and municipal government, and the bulk of the Manhattan business district as shown on the "Hazard Map" figure of the FEvR.

In order to be protective of the downstream population, the Enhanced Emergency Action Planning alternative would consist of the purchase, and demolition of existing residences and businesses in the areas inundated to the greatest depth and with the highest water velocities. This area includes the vast majority of the area between Tuttle Creek Dam and the Kansas River. Around the fringes of the potentially flooded area where flooding depths and velocities are less, flood proofing to minimize and prevent damage to the structures may be feasible to a limited extent. Additionally, local zoning measures would be implemented to prevent future development and use of the floodplain.

The dam failure warning system as described in Section 7. Dam Failure Warning System and Evacuation Plan would serve as a component of this alternative during the period of property acquisitions and relocations to protect the population remaining in the impacted area. In and of itself, the dam failure warning system is a form of Enhanced Emergency Action Planning in that it minimizes risk to the downstream population. This dam failure warning system will be carried forward as a portion of or interim measure into several alternatives.

The Enhanced Emergency Action Planning alternative would be expected to cost at least \$848 million just for the purchase of impacted properties. This cost does not include the costs associated with relocation expenses, demolition, restoration, or program administration.

This alternative would have significant social impacts since it would remove the development in some of the most recently developed areas of Manhattan and Riley County and would require relocation of these properties. These properties include critical facilities and infrastructure including residences, schools, day cares, industrial business parks, emergency services, county and municipal government, and the bulk of the Manhattan business district including the Manhattan mall. Potentially, some of these businesses and industrial facilities could relocate outside the Manhattan area. Residences and businesses that did relocate within the Manhattan area would probably relocate to currently undeveloped areas. These relocations would result in additional social, economic and environmental impacts.

The Corps of Engineers is not currently authorized to implement this alternative and specific Congressional authorization would be required. Additionally, implementation of the property purchases and relocations would be the

responsibility of the state or county. The Enhanced Emergency Action Planning alternative would be entirely voluntary and residents and businesses could not be forced to relocate from the floodplain.

Initial community input during scoping did not support this alternative and some community members expressed willingness to accept the risks associated with earthquake damage to Tuttle Creek Dam. This willingness to accept risk, combined with a voluntary downstream relocation program, would further limit the effectiveness of this alternative at protecting against loss of life in the event of seismic related uncontrolled release of the Tuttle Creek pool.

This option would provide the benefit that the land vacated by development could be used for agricultural, recreation, and wildlife habitat.

Based on the lack of community support during scoping, potential adverse social and economic effects to the Manhattan community, high costs, and probable ineffectiveness of this alternative to actually achieve the stated project purpose, the Enhanced Emergency Action Planning alternative was removed from further consideration.

2.1.4 Enhanced Drainage Capacity (B.5 in FEvR)

Through the scoping process, a question arose as to whether an alternative that would allow the lake to be drained quickly after a major seismic event could be developed. Currently, the two existing 20-foot-diameter conduits cannot release enough water to allow any appreciable draining of the lake within the projected 2-6 hours before failure after an MCE. The alternative of enhanced reservoir drainage capacity consists of the ability to rapidly drain the lake to an area downstream of the City of Manhattan in a controlled manner after a major earthquake. This alternative does not involve any modifications to the dam to minimize or prevent damage due to an earthquake. This alternative does reduce the potential for an uncontrolled release of the lake through a dam breach by rapidly dropping the lake to a safe level.

Drainage features such as open channels, tunnels, and pipelines were considered as potential engineering features for this alternative. In order for this alternative to be effective, the channel, tunnel, or pipeline would need to be constructed such that it would be able to lower the lake a minimum of 25 feet within a few hours. Therefore, the base of the tunnel, channel, or pipe would need to be constructed near the bottom of the lake and would have to drain to an area well below the lake bottom elevation. Gates that could be rapidly opened would seal the upstream end of the drain and the gates would only be opened in an emergency earthquake situation.

The entire area at and around the shoreline at the normal lake level was examined to determine if a channel could be constructed that would allow the lake to be drained through a surface channel. Due to the surrounding topography of the Flint Hills, an open channel was determined to not be a potential option.

Overland pipelines were considered that would carry flows down the Big Blue River valley and discharge them to the Kansas River downstream of the confluence of the Kansas and Big Blue Rivers. Due to the required size of the pipelines, the real estate and maintenance requirements, and the potential impacts of routine high water on the pipeline, surface piping was determined to not be a potential option.

Tunneling was evaluated as a potential option for creating a means of draining the lake. Potential alignments for tunneling were evaluated both to the west and east of the main body of the lake. Any drainages to the west of the lake that are low enough in elevation to allow a tunnel to be used to drain the lake, drain directly into the City of Manhattan and are not feasible. Potentially feasible tunnel alignments are shown on the "Potential Tunnel Alignment" figure at the end of this report.

Tunneling options to the east of the lake were the only potentially feasible tunneling option. The shortest potential tunnel alignment would start just upstream of the spillway and would discharge at the mouth of Plum Creek on the north bank of the Kansas River just north of Zeandale. This alignment would pass just north of the Pottawatomie County fishing lake and would be approximately 9 miles long.

In order to drop the lake level at least 25 feet in a few hours a series of approximately sixteen, 20-foot diameter horseshoe shaped tunnels would be required. Dropping the reservoir from elevation 1,075 to 1,050 over a period of four hours would require the evacuation of approximately 215,000 acre-feet of water from the reservoir. An average flow to the Kansas River of 650,000 cubic feet per second would be required to achieve this drawdown. It should be noted that this discharge is an average and the peak discharge required would most likely be significantly higher. In perspective, a 650,000 cfs discharge is higher than the spillway design discharge during the Probable Maximum Flood.

The methods and features listed below would be incorporated into this alternative:

- A grout curtain 60 feet deep and 1,600 feet long surrounding the upstream end of the tunnels and the excavation for the intake structure. The excavation for the upstream end of the tunnels and the intake structure is assumed to be 600 feet by 100 feet.
- An intake structure approximately 60 feet tall constructed on the east side of the lake upstream of the spillway.
- Sixteen 20-foot diameter concrete lined tunnels reinforced to withstand earthquakes. These tunnels are assumed to be constructed using road header equipment and limited blasting through alternating layers of limestones, shales, and siltstones.

- To control flow through the tunnels, counterweighted butterfly valves would be used. These valves would be remotely controlled by a microwave system from the lake project office with a redundant manual system in the intake structure.
- Stilling basins approximately equivalent to the existing project stilling basin for each pair of tunnels would be constructed in excavations into the rock of the hillside adjacent to Plum Creek.
- A downstream riprap lined discharge channel approximately 300 feet long and 20 feet deep with 1 on 3 side slopes.
- A downstream discharge warning siren system.
- All soil and rock from tunnel and structure excavations would be used to construct a berm on the downstream side of the dam to minimize deformation as a result of the earthquake. Due to the stabilizing affect of this berm, the allowable time for reservoir drainage would be increased to four hours.
- Closure of the existing relief wells and installation of a new relief well system downstream of the new berm.
- Since the tunnel and stilling basin approach the town of Wamego where the earthquake would be centered, all of the structures would be earthquake resistant.

In addition to the real estate required to construction of the intake structure, stilling basin and discharge channel, road access and access for three permanent vertical access and supply shafts would also be required along the tunnel alignment.

This alternative does have the advantage of requiring minimal reservoir drawdown during construction and would maintain the Congressionally authorized project purposes. However, due to the high construction uncertainty and risks, high cost to construct and maintain, failure to eliminate downstream flooding and potential loss of human life and property, and requiring human intervention to operate after a seismic event, this alternative was removed from further detailed consideration.

2.1.5 Reinforce Embankment (C.1 in FEvR)

The Corps investigated measures to reinforce the embankment in order to preserve the dam intact after a major seismic event. Two methods to reinforce the embankment were evaluated: reinforce structure with piles and reinforce structure with anchors. These methods are illustrated in Figures 7.5 and 7.6 of the FEvR. These alternatives were determined to not be technically feasible and were eliminated from detailed analysis.

2.1.6 Breach Embankment (D. in FEvR)

This alternative consists of removing a section of the Tuttle Creek dam (Figure 7.11 of the FEvR). The breach would need to be wide enough to allow for the safe passage of a major flood event. The remaining fill associated with the dam and in the old lakebed would need to be protected from erosion. Under this alternative the project would no longer provide any flood control, water quality, water supply, or navigation benefits. Considering fish and wildlife resources, more terrestrial habitat would be available under this alternative. In addition, a shift in the makeup of aquatic organisms would be expected as the habitat of the current lake was replaced by the river system. Recreation would be more oriented towards the river and surrounding lands as opposed to the current lake based recreation. The Corps would probably also be required to transfer project lands and operation of the area to another state or Federal agency, with some lands potentially returning to private ownership. The Corps does not currently have the authority to implement this alternative and authorization would be required from Congress. This alternative would not maintain the current Congressionally authorized project purposes. This alternative was not selected for further consideration because of the severe environmental and economic impacts associated with the loss of the authorized project purposes. In addition, the majority of commenters during the scoping process expressed their objection to alternatives that did not include continued operation of the lake in accordance with the current authorization.

2.1.7 Replace Embankment (E. in FEvR)

This alternative consists of constructing a new dam immediately downstream from the existing dam (Figure 7.12 of the FEvR). The new dam would have similar height and features of the existing structure. A new relief well system or positive cutoff would also need to be incorporated in the project design. If built immediately downstream of the existing structure, the new dam could utilize the existing spillway and outlet works. This alternative would still require treatment of the foundation soil since the soil downstream of the existing dam would still be susceptible to liquefaction unless treated. Authorized project purposes would be maintained. This alternative would require temporary lowering of the pool during construction. A large amount of borrow material would have to be excavated from an upland site and trucked to the downstream side of the dam or hydraulically dredged from the Tuttle Creek Lake. Locations for potential sources of dredge material within the lake are over 5 miles from the dam and would require a pipeline to pump the material to the construction site. Several commenters during the scoping process suggested that silt that has accumulated in the lake above the State Route 16 bridge could be utilized to construct the new dam. Considering the availability of closer borrow sources and the distance that this material would have to be pumped, sediment located above the Highway 16 bridge would not be a practicable source for material. In addition, even though a large amount of material would be required to build the new dam, this amount of material would provide only a very minor reduction in the total existing siltation above State Highway 16 bridge.

849 In addition, this alternative would have severe negative impacts to
850 recreational areas in Kansas Department of Wildlife and Park's leased area at River
851 Pond State Park. Recreational facilities at River Pond State Park would be
852 displaced by the new structure. This area is one of the most popular recreation
853 areas at the lake. This alternative was removed from further consideration because
854 of high cost and adverse environmental impacts associated with obtaining the large
855 amount of borrow material necessary to construct the new structure and impacts to
856 recreation at River Pond State Park. Therefore, it was dropped from further
857 consideration.

858 859 **2.2 Alternatives for further consideration in the FEvR/FEIS**

860
861 In developing alternatives for further consideration in the FEvR/FEIS, the
862 Corps has identified three structural engineering repairs, Enlarge Embankment,
863 Stabilize Foundation Soil with Drawdown, and Stabilize Foundation Soil without
864 Drawdown (the preferred alternative), that would maintain all Congressionally
865 authorized project purposes and fully comply with Corps dam safety regulations. As
866 required by NEPA, the Corps must consider reasonable alternatives that are not
867 within the jurisdiction of the agency. Several commenters during the scoping
868 process expressed that there was such a remote possibility of a major earthquake
869 affecting Tuttle Creek dam that the downstream population should accept that risk
870 and that the Corps should investigate less costly measures to minimize the potential
871 for loss of human life and property damage. One alternative that addresses these
872 concerns (Restricted Lake Operation) was moved forward for consideration in the
873 FEvR/FEIS. This alternative is outside the jurisdiction of the Corps and would
874 require Congressional authorization. Finally, in accordance with NEPA, and to
875 provide the reviewer with baseline information, the "No Action" Alternative, presents
876 what would be reasonably expected to occur if the Corps would take no action to
877 address the seismic stability of Tuttle Creek Dam. The following is a complete
878 description of the alternatives investigated in detail for this study.

879 880 **2.2.1 The "No Action" Alternative (A in FEvR)**

881
882 The "No Action" Alternative would consist of doing nothing and continuing to
883 operate Tuttle Creek Lake in accordance with current project authorization and the
884 Lake Regulation Manual. Based on our initial analysis of the seismic threat and the
885 performance of Tuttle Creek dam should an event of that magnitude occur, the
886 Corps has made a determination that Tuttle Creek dam would not survive a major
887 seismic event and the result would be the uncontrolled release of the Tuttle Creek
888 pool. The uncontrolled release of the pool would result in substantial property
889 damage and potential loss of human life. Since the Corps has identified seismic
890 performance deficiencies in the Tuttle Creek Dam, our Dam Safety Regulations
891 require us to address these conditions. The "No Action" alternative is primarily
892 included to provide a baseline for reviewers of what we would expect to happen if a
893 major seismic event occurred. Consideration of the "No Action" alternative is
894 required by NEPA. As noted above, several commenters during the scoping
895 process expressed that there was such a remote possibility of a major earthquake
896 affecting Tuttle Creek dam that the downstream population should accept that risk.

2.2.2 Restricted Lake Operation (B.4 in FEvR)

Restricted Lake Operation, see Figure 7.4 of the FEvR: The Restricted Lake Operation alternative would involve the permanent lowering of the pool from its current multipurpose pool elevation of 1,075 ft., m.s.l. to a new multipurpose pool elevation of 1,050 ft., m.s.l. This would reduce the multipurpose pool surface area of the lake from the current 12,500 acres to 7,211 acres. The 1,050 ft., m.s.l. elevation was selected because permanently lowering the pool to this new multipurpose elevation would prevent failure by piping if the relief pressure system becomes non-functional following large deformations of the dam associated with a major seismic event. Tuttle Creek Lake would continue to be used for flood control purposes and at times would be above the 1,050 ft., m.s.l. elevation. Initially, provided that the pool is at the multipurpose pool elevation 1,075 ft., m.s.l., it would require approximately one month of releasing water to achieve the 1,050 ft., m.s.l. elevation. Recreation areas would be modified and newly exposed areas of the lakebed would be stabilized. To operate the pool in this manner is not consistent with the current project authorization and would require a reallocation of the project and Congressional approval. Since the pool would many times be above the 1,050 ft., m.s.l. elevation when operating for flood control, the proposed interim measure described in 7. Dam Failure Warning System and Evacuation Plan would be utilized under this alternative to provide long-term benefits to minimize the potential for loss of human life.

2.2.3 Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

Stabilize Foundation Soil with Drawdown includes treatment of both the upstream and downstream foundation soil. The area where construction activity would occur is shown in Figure 4 – Tuttle Creek Dam Proposed Construction Areas. Although the pool would be drawn down to elevation 1,050 ft., m.s.l. during the 7-10 year construction period, many times the lake would be above this elevation when operating for flood control. This alternative would include the installation of instrumentation to monitor the post-construction performance of the dam should a major seismic event occur. The proposed interim measure described in Section 7. Dam Failure Warning System and Evacuation Plan would be utilized under this alternative to minimize the potential for loss of human life until the construction activity could be completed.

Upstream:

Jet Grouting with Cutoff (see Figure 7.7 of the FEvR): Jet grouting involves the replacement of liquefiable material in the foundation by onsite mixing of cement grout and soil. This process involves drilling vertically to a predetermined depth using conventional rotary drilling techniques and injecting high pressure air and grout through two opposing nozzles located above the drilling bit. The soil is eroded and mixed with the cement grout to create a soilcrete column from the bottom of the hole upward. Spoil material, consisting of soil and cement grout, is discharged from the top of the hole during the process. The diameter of the soilcrete column is controlled by the grout pumping rate, grout pumping pressure, lift

rate, and rotational speed of the nozzles. Construction could begin as early as September 2004. Initially, a 70-foot-wide work platform would be constructed across the upstream face of Tuttle Creek dam. The work platform would be constructed in the “dry” utilizing a hydraulic excavator to loosen existing rock on the face of the dam and heavy equipment to place the material. Silt curtains would be placed around the perimeter of the work area to minimize turbidity impacts. The work platform would be constructed of approximately 115,00 cubic yards of existing rock from the upstream face of the dam. The work platform would have a top elevation of 1,090 ft., m.s.l. This work platform would be left in place upon completion of the project. Jet grouting would occur between elevation 1,022 ft., m.s.l. and 992 ft., m.s.l. for stabilization and between elevation 992 ft., m.s.l. and 960 ft., m.s.l. to create a positive cutoff that would significantly reduce the amount of water migrating through the structure. Between Station Nos 48+00 and 50+00 (the old river channel area) jet grouting would extend to elevation 920 ft., m.s.l. in order to achieve a positive cutoff. Jet grouting would require the drilling approximately 9,000 3-foot-diameter holes and approximately 179,00 cubic yards of cement/bentonite mixture. Excess spoil from the drilling operation would be utilized for berm. **Pool drawdown:** The lake would be drawn down to a target elevation of 1,050 ft. m.s.l. during upstream construction. This would reduce the multipurpose pool surface area of the lake from the current 12,500 acres to 7,211 acres. During the nesting season of downstream threatened and endangered species, discharges would be regulated such that nesting would not be impacted. As such, the pool may be above elevation 1,050 ft. m.s.l. a significant portion of the year. However, the goal would be to maintain the lake at or near elevation 1,050 ft. m.s.l. during upstream construction work. Prior to the beginning of construction, provided that the pool is at the multipurpose pool elevation 1,075 ft., m.s.l., it would require approximately one month of releasing water to achieve the 1,050 ft., m.s.l. elevation.

Downstream:

Deep Soil Mixing (see Figure 7.7 of the FEnvR): Deep soil mixing would involve the drilling of a series of 3-foot diameter holes, deep into the foundation, and in close proximity to each other. The earthen material that is drilled from the holes would be mixed in place with liquid cement to form a stabilized zone in the foundation. Approximately 900,000 cubic yards of existing material on the downstream face of the dam would be excavated to create a 115-foot-wide work platform with a top elevation of 1,040 ft., m.s.l. Deep soil mixing would be accomplished by drilling approximately 27,000, 3-foot-diameter holes, 50 feet deep to achieve a 40% improvement in the foundation soil. The treatment zone would be at elevation 1,025 ft., m.s.l. to 983 ft., m.s.l. In addition, the area around the existing relief well system would be treated, requiring approximately 962 holes to a 30-foot-depth. Deep soil mixing would require that approximately 419,000 cubic yards of earthen material would be drilled and that approximately 237,000 cubic yards of cement would be used in the mixing. Approximately 30% of the total material drilled would be spoil and would be placed in the berm. The berm would be graded, stabilized and left in place upon completion of construction. **Pool drawdown:** Deep soil mixing on the downstream side of the dam would not require any lowering of the

pool. To ensure dam safety, a pool level will be determined, at which, downstream stabilization measures would be halted for dam safety reasons. This pool would likely be high enough that, discontinuation of downstream work due to high pools would be relatively infrequent. The level of discharges, at which downstream stabilization work would need to be stopped, would also require consideration since sufficiently high discharges can back water into downstream work areas.

Testing of Proposed Treatment Methods:

The Corps determined that the methods to stabilize the foundation soil, described above, would result in the necessary level of improvement to ensure performance of the dam during a major seismic event. The Corps, in order to verify this assessment, and as part of the Stabilize Foundation Soil with Drawdown alternative, proposes to construct several test sections of treatment on Tuttle Creek Dam to field verify the level of improvement that can be achieved. Based on this testing, the Corps would then make adjustment in the method and extent of the treatment necessary to stabilize the foundation soil as part of the final design effort. Very specific treatment descriptions have been identified above to provide the reviewer with information concerning what the Corps currently expects would be necessary to stabilize the foundation soil. Field testing of the treatment methods could result in changes or variations in the extent of the treatment area, quantity of material utilized, number of holes drilled, use of deep soil mixing or jet grouting to treat a specific area, and costs. The current technologies of Jet Grouting and Deep Soil Mixing are proposed. However, as technologies improve and develop, adjustments to the exact nature of the soil stabilization, equipment, techniques, and admixtures may be made. It may also be possible that either technology may be used both upstream and downstream to avoid weather and pool related delays. The overall disturbed area, type of effects, and time needed to complete construction would not be expected to change. The required level of performance for the dam during a major seismic event is established by Corps Dam Safety Regulations, and therefore could not and would not be reduced.

2.2.4 Stabilize Foundation Soil without Drawdown (preferred alternative, C.2 in FEvR)

Stabilize Foundation Soil without Drawdown (preferred alternative, C.2 in FEvR) would involve exactly the same type of work as described under the **Stabilize the Foundation Soil with Drawdown** except the construction of the work platform on the upstream side of the dam would be completed in the “wet” and the lake would not be drawn down to elevation 1,050 ft., m.s.l. for the 7-10 year construction period. The Corps has identified **Stabilize Foundation Soil without Drawdown as the Preferred Alternative** and proposes to implement these measures to meet the project purpose and needs. The pool will be at or above the multi-purpose pool elevation of 1,075 ft., m.s.l. during the 7-10 year construction period. This alternative would include the installation of instrumentation to monitor the post-construction performance of the dam should a major seismic event occur. The proposed interim measure described in Section 7. Dam Failure Warning

System and Evacuation Plan would be utilized under this alternative to minimize the potential for loss of human life until the construction activity could be completed.

2.2.5 Enlarge Embankment (C.3 in FEvR)

The Enlarge Embankment Alternative consists of the construction of large earthen berms on both the upstream and downstream slopes of the dam. Use of existing rock on the dam, spoil from deep soil mixing/jet grouting and material dredged from nearby areas would be used to construct these berms. This alternative would also require some treatment of the foundation soil by jet grouting on the upstream slope and deep soil mixing on the downstream slope. This treatment would include the construction of a positive cutoff. Since the weight of the large berms increases the stability of the dam, the deep soil mixing/jet grouting areas would not be as extensive as under the Stabilize Foundation Soil Alternative (preferred). This alternative includes removal of the old pressure relief well system and the construction of a new system. The area where construction activity would occur is shown in Figure 4 – Tuttle Creek Dam Proposed Construction Areas. This alternative would include the installation of instrumentation to monitor the post-construction performance of the dam should a major seismic event occur. Although the pool would be drawn down to elevation 1,050 ft., m.s.l. during the 7-10 year construction period, many times the lake would be above this elevation when operating for flood control. The proposed interim measure described in 7. Dam Failure Warning System and Evacuation Plan would be utilized under this alternative to minimize the potential for loss of human life until the construction activity could be completed.

Upstream: Large berm with soil stabilization (see Figure 7.9 of the FEvR): A berm would be constructed across the upstream face of the dam by utilizing approximately 285,00 cubic yards of the existing rock on the face of the dam to create a containment dike and then backfilling the area with approximately 2,500,000 cubic yards of dredged material from nearby areas in Tuttle Creek Lake. The berm would be approximately 400 feet wide and has a top elevation of approximately 1,080 ft., m.s.l. to 1,100 ft., m.s.l. Once this berm is established jet grouting would be used to stabilize a 50-foot-wide band (Range –570 to –520) of the foundation soil. The area stabilized by jet grouting would be between Station Nos. 25+00 and 75+00 and have a bottom elevation of 992 ft., m.s.l. Jet grouting involves the replacement of liquefiable material in the foundation by onsite mixing of cement grout and soil. This process involves drilling vertically to a predetermined depth using conventional rotary drilling techniques and injecting high pressure air and grout through two opposing nozzles located above the drilling bit. The soil is eroded and mixed with the cement grout to create a soilcrete column from the bottom of the hole upward. Spoil material, consisting of soil and cement grout, is discharged from the top of the hole during the process. The diameter of the soilcrete column is controlled by the grout pumping rate, grout pumping pressure, lift rate, and rotational speed of the nozzles. Jet grouting would require the drilling of approximately 6,700 3-foot-diameter holes and the injection of approximately 104,000 cubic yards of cement. This would result in an equal amount of earthen material removed from the holes and used for berm construction. Jet grouting

would result in a 40% improvement in the foundation soil. **Pool draw down:** The lake would be drawn down to a target elevation of 1,050 ft. m.s.l. during construction of the upstream berm. This would reduce the multipurpose pool surface area of the lake from the current 12,500 acres to 7,211 acres. During the nesting season of downstream threatened and endangered species, discharges would be regulated such that nesting would not be impacted. As such, the pool may be above elevation 1,050 ft. m.s.l. a significant portion of the year. However, the goal would be to maintain the lake at or near elevation 1,050 ft. m.s.l. during upstream construction work. The work would be expected to start in 2004 and would continue for approximately seven to ten years. Upstream work would be performed concurrently with downstream work. Any additional material required for construction of the berm would be expected to come from commercial quarries, dredging of the downstream river pond and upland commercial borrow areas. Prior to the beginning of construction, provided that the pool is at the multipurpose pool elevation 1,075 ft., m.s.l., it would require approximately one month of releasing water to achieve the 1,050 ft., m.s.l. elevation.

Downstream: Large berm with soil stabilization (see Figure 7.9 of the FEvR): A berm would be constructed across the downstream face of the dam by utilizing approximately 318,000 cubic yards of the existing rock on the downstream face of the dam to create a containment dike and then backfilling the area with approximately 2,200,00 cubic yards of dredged material from nearby areas in River Pond. Any additional material required for construction of the berm would be expected to come from commercial quarries and upland commercial borrow areas. The existing pressure relief well collector ditch would be filled with rock fill. The berm would be approximately 425 feet wide and has a top elevation of approximately 1,095.0 ft., m.s.l. to 1,073.75 ft., m.s.l. Once this berm is established, deep soil mixing would be used to stabilize the foundation soil. The area stabilized by deep soil mixing would be two zones creating an 80-foot-wide area, at least between Stations 35+00 and 70+00. The necessity of downstream remediation between Stations 25+00 and 35+00 and between Stations 70+00 and 75+00 is presently uncertain and more investigation will be completed in order to develop the final design. The treatment area would consist of a 15-foot-wide zone between the existing toe and pressure relief well collector ditch (Range 526 to 541), and a 65-foot-wide zone south of the relief wells (Range 590 to 655). Bottom elevation of the treatment would be elevation 983.0 ft., m.s.l. Deep soil mixing would require the drilling of approximately 19,000 holes and approximately 1,624,000 cubic yards of cement. Unlike jet grouting where all material from the drill hole is replaced by cement, deep soil mixing uses a mixture of 70% of the existing earthen material mixed with 30% cement. This would result in approximately 30% of the total amount of earthen material being removed from the holes and used for berm construction. Soil mixing would result in a 40% improvement in the foundation soil. A new road would be constructed adjacent to the new pressure relief well collector ditch. **Pool draw down:** While there is no pool draw down necessary to complete

the downstream work, the downstream work is expected to occur concurrently with upstream work, which requires the pool lowering, described above. The work would be expected to start in 2004 and would continue for approximately seven to ten years.

3. Affected Environment

3.1 Physical-Chemical Environment

3.1.1 Geology, Minerals and Soils

The Blue River basin lies within the Interior Plains region and is about evenly divided between the Great Plains and the Central Lowland Physiographic Provinces. The portion of the Central Lowlands Province north of Randolph, Kansas, lies in the Dissected Till Plains section, which was glaciated during the Pleistocene time. The Dissected Till Plains section is now covered by glacial drift, which forms a discontinuous mantle over much of the area, attaining a maximum thickness of 300 feet. The basin south of Randolph, which surrounds the project, is part of the Osage Plains section. Bedrock in the vicinity of Tuttle Creek Lake dam is overlain by alluvial deposits 10 to 50 feet deep. Bedrock exposed along valley walls consists of a sequence of limestones and shales of the Permian age belonging to the Council Grove group. Another 2,000 feet of shales and limestones of the Pennsylvanian age are located below this stratum. Weathering of bedrock consists of moderate to extensive softening of the shales and moderate pitting of the limestone.

Soils of the area draining into Tuttle Creek Lake can be divided according to tributary basins. The terrain of the Little Blue River basin is nearly level. The soils are silt loams and silty clay loams developed from loess. Soils of the Blue River basin are silty clay loams derived from loess, shale, and limestone residuum. The terrain of the basin below the confluence of the Blue and the Black Vermillion Rivers is steep to undulating. The soils of this area are stony cherty.

Currently the Corps administers fifteen (15) permits, under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403), for commercial hydraulic dredging of sand from the Kansas River. All of these hydraulic sand dredging operations are located downstream of Tuttle Creek Lake on the Kansas River.

3.1.2 Climate

The climate of the Big Blue River basin varies from moist subhumid in the southeast to dry subhumid in the west. Historically, the climate includes some years with intense and prolonged rainfall and some with severe droughts with no fixed cyclic pattern.

Normal annual rainfall for the basin above Tuttle Creek Lake dam is 27.4 inches. The maximum recorded was 40.8 inches in 1902, and the minimum was 15.9 inches in 1936. In general, the annual precipitation throughout the basin

decreases from east to west. Within the basin, the maximum-recorded rainfall within any one-year at a specific location was 60.38 inches at Manhattan in 1951 while the minimum was 10.31 inches recorded at Clay Center, Nebraska in 1936.

Precipitation during the summer and fall months is usually of the short duration thunderstorm type with small centers of high intensity, although widespread general rains occasionally occur. Winter precipitation usually results from the passage of well-developed low-pressure systems and active fronts and occurs as either rain or snow. Significant amounts of snowfall are confined to the months of October through April inclusive, with the highest monthly average in January, February, and March. The average annual snowfall for the basin is 22 inches.

Excessively high and low temperatures are characteristic of the plains area. The average annual temperature varies from about 55 ° F in the west to 88 ° F in the east. Severe winter weather is normally experienced in December, January, and February, and is encountered rather frequently in November and March. July and August are normally the hottest summer months, but maximum temperatures of over 100 ° F have been recorded in all months, April through October. Temperatures of 10 ° F to 25 ° F below zero have been recorded November through April, inclusive. For the last 10 years, the Tuttle Creek Lake had been 95 to 100 percent ice covered from mid-January until March.

3.1.3 Water Resources and Water Quality

Water resources in the project area include surface water resources and groundwater resources. Surface water resources in the project area include the Big Blue River, Tuttle Creek Lake, the Kansas River, their tributaries and adjacent wetlands. Groundwater resources in the project area include alluvial aquifers of the Big Blue and Kansas Rivers and their tributaries along with portions of the Glacial Drift and Dakota aquifers. Tuttle Creek Lake is located in the Lower Big Blue Watershed (HUC 10270205) and is ranked second in priority by the Kansas Department of Health and Environment (KDHE) for watershed restoration in the State of Kansas. The Middle Kansas Watershed (HUC 10270102) includes the Kansas River and its tributaries downstream from Tuttle Creek Lake to near Topeka. The Middle Kansas Watershed is ranked fourth by the KDHE for watershed restoration in the State of Kansas.

Federal water quality standards regulations require that States specify appropriate water uses to be achieved and protected by taking into consideration the use and value of the water body for public water supply, for propagation of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes, these “uses” are known as “Designated Uses”. In designating uses for a water body, States examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and the social-economic and cultural characteristics of the surrounding area.

States adopt water quality criteria with sufficient coverage of parameters and of adequate stringency to protect designated uses. Once Water Quality Standards have been adopted by the States and approved by EPA, they are used in determining National Pollutant Discharge Elimination System (NPDES) permit limits, impairment status, and Total Maximum Daily Load (TMDL) endpoints. If a water body is determined to be impaired or not meeting Water Quality Standards, then the water body is listed on the Clean water Act section 303(d) list.

Tuttle Creek Reservoir is currently listed as being “impaired” (not meeting designated uses) due to four water quality standards parameters: Eutrophication, Sedimentation, Atrazine and Alachlor. Total Daily Maximum Loads have been developed and approved by the U.S. Environmental Protection Agency for this high priority waterbody. The approved TMDL can be viewed at <http://www.kdhe.state.ks.us/tmdl/klrtmdl.htm>.

Impaired

<u>Parameter</u>	<u>Criteria</u>	<u>Use</u>
Alachlor	2 ug/L	Domestic Water Supply
Atrazine	3 ug/L	Drinking Water, Aquatic Life Support (Chronic)
Eutrophy (Nutrients)	Narrative	Aquatic Life Support, Recreation, Drinking Water
Siltation/Sediment (Suspended Solids or Turbidity)	Narrative	Aquatic Life Support

The water quality of Tuttle Creek Lake is at best only moderately good. The high-suspended solids load entering the lake during storm events has caused sedimentation in the upper third of the original pool. The associated turbidity adversely affects the sport fishery and, therefore, the recreation benefits of the project. Pesticide surveys continue to show heavy herbicide loading is associated with the storm run-off. The lake is acting as a pesticide sink with the result that its discharges contain pesticide concentrations throughout the year, which are significantly lower than those of the inflows during storm events but elevated above the levels present in the tributaries during non-storm event periods. The continually elevated levels pose a risk to water supply benefits for the Kansas River. Atrazine concentrations for the impoundment during the period of record show a continued exceedence of the EPA criterion of 1 ug/L for the protection of aquatic life. The concentrations in many periods exceed the EPA MCL of 3 ug/L, the maximum permissible level of a contaminant in public drinking water supplies. If soil conservation practices are not substantially improved and pesticide usage altered, the conditions will only worsen, which will sharply reduce the project’s benefits of flood control, water quality, and recreation.

Section 404 of the Clean Water Act (CWA) (33 USC 1344) requires that all activities that involve a discharge of dredged or fill material in a Water of the United States, unless exempted, requires prior authorization from the Corps of Engineers. In addition, projects authorized under Section 404 of the Clean Water Act must also be certified in compliance with applicable state water quality standards. In Kansas the request for Section 401 Water Quality Certification is evaluated by the Kansas Department of Health and Environment-Bureau of Environmental Quality. At Tuttle Creek Lake, the ordinary high water mark, which is the jurisdictional boundary, is 3 feet above the multipurpose pool elevation, at 1,078 ft., m.s.l. Any fill activities below this elevation, i.e. jet grouting, deep soil mixing, construction of berms, etc. would require that the Corps evaluate the proposed activity for compliance with the requirements of Section 404 of the Clean Water Act, including a Section 404(b)(1) Evaluation. If found in compliance with Section 404 of the CWA, the Corps would be required to secure a Section 401 Water Quality Certification from the State of Kansas prior to initiating the proposed work. In addition, any fill or excavation activities in River Pond or adjacent wetlands would require Section 404/401 authorization. Appendix G of this document contains the Section 404 of the Clean Water Act Compliance Review Documents including the Public Notice and Draft 404(b)(1) Evaluation. Appendix J of this document contains the Kansas Department of Health and Environment's Section 401 Water Quality Certification, dated August 29, 2002, for the proposed work described under the preferred alternative. Wetland resources are described in Section 4.2.2 Aquatic Ecosystem (including wetlands and fisheries).

3.1.4 Air Quality

Air quality monitoring by KDHE indicates that the air in Kansas is relatively clean. Currently there are no designated nonattainment areas in Kansas. Sources of air pollution in the project area would include stationary sources such as electrical power plants and industrial facilities, mobile sources such as vehicle emissions, and area sources such as small businesses and households. Within the State of Kansas, the highest levels of air pollution are associated with the most heavily urbanized areas of the state in Johnson and Wyandotte Counties on the eastern terminus of the study area, and Sedgewick County which is outside the study area. As with the vast majority of the State, air in the Manhattan and Tuttle Creek Lake area is considered to be relatively clean.

3.1.5 Noise

Tuttle Creek Lake is located in a fairly rural setting and existing levels of noise are typically very low. Sources of noise would include powerboats, radio-controlled airplanes, vehicles using project roadways, off-road vehicles, the discharge of firearms associated with hunting, mowing and agricultural equipment, and the annual music concert. Some of these noise sources are restricted to fairly small well-defined areas of the project like the radio-controlled flying field, cycle park or off-road area. Some of these noise sources are seasonal like boating which typically peaks during summer holiday weekends or mowers in improved park areas during the summer season. Summer weekends typically would have the highest

amount of visitation and correspondingly the highest levels of noise. Winter weekdays during the lowest period of visitation would probably produce the lowest amounts of noise. No known off-site noise sources adversely affect the recreational users at Tuttle Creek Lake. While certain project visitors may experience short-term adverse noise impacts resulting from the activities of other project visitors, most of the sources are typical of what one would expect at a multi-use recreation area and are usually short term or easily avoided. Low noise levels are typically one of the most highly valued attributes recreational users assign to park and natural areas.

3.1.6 Hazardous Waste Management

Environmental Protection Agency (EPA) databases were reviewed to determine the impact of a dam breach on hazardous waste sites downstream from Tuttle Creek Lake. No National Priority List Comprehensive Environmental Response and Liability Act sites are located in the area that would be inundated by water if a dam breach were to occur. There were 65 Resource Conservation and Recovery Act (RCRA) sites found within the inundated area. The EPA RCRA database included large and small hazardous waste generators, hazardous waste transporters, and hazardous waste disposers.

3.2 Biological Environment

3.2.1 Terrestrial Ecosystem

Two major types of terrestrial ecosystems exist at the Tuttle Creek Lake project, woodlands and rangeland. Native woodlands occupy approximately 19 percent of the public use areas and occur generally as narrow bands and patches of trees along creeks and intermittent streams draining into the lake, and on steep slopes and breaks that border the conservation pool. With the exception on the eastern red cedar, which occurs as scattered individuals or clumps, woodlands at the project are of the eastern hardwood type.

Much of the area can be classified as true rangeland. The entire lake area lies in the Kansas-Oklahoma Bluestem-Limestone (Flint Hills) Region, and represents a portion of the only extensive area of natural grazing land classed as a humid tall grass prairie region. The terrain consists of long steep slopes with limestone and flint rock escarpments, which face the Big Blue River and larger streams. Soils are quite shallow over bedrock consisting of limestone and flint rock.

The climax cover is a mixture of the tall and mid-grasses characteristic of the true prairie. Big bluestem is dominant on the lower slopes and little bluestem on the upper slopes. About 85 percent of the cover consists of the bluestems, Indiangrass, switchgrass, and prairie dropseed. Side-oats grama and tall dropseed are usually the first grasses to increase under grazing. The principle invaders are woody plants, ironweed, Kentucky bluegrass, vervain, windmill grass, tumblegrass, and annuals, depending upon the available moisture. Woody plants are most likely to invade sites on north slopes, in steep areas, and on rocky slopes.

A complete list of the species (both terrestrial and aquatic) that have been documented at the Konza Prairie Biological Station, and therefore could typically be found at the Tuttle Creek Lake Project, is located on the Konza Prairie LTER web page (<http://climate.konza.ksu.edu>) under on-line data. The NSF Long Term Ecological Research Program at Konza Prairie Biological Station supports this data.

3.2.1.1 Vegetation

The USFWS in the CAR notes that the Big Blue/Lower Kansas River basin encompasses three potential natural vegetation types: Flood plain Forest (*Populus-Salix*), Oak-Hickory Forest (*Quercus-Carya*), and Bluestem Prairie (*Andropogon-Panicum-Sorghastrum*). Two specific associations are most commonly found along the lakeshore of Tuttle Creek Lake. These include the cottonwood-willow and the elm-ash-silver maple. In addition, there are extensive areas of agricultural crop ground in the project area, especially on the floodplain of the Big Blue and Kansas Rivers. Corn, milo and soybeans dominate these areas and this production provides numerous jobs and economic benefits to the area. No Federally listed threatened or endangered plants were identified in the project area.

A complete description of vegetation resources in the project area is included in the USFWS-CAR, included as Appendix B. In addition, a list of typical vegetation found in the project area is included as Appendix D - Common Trees, Shrubs and Grasses of the Project Area.

3.2.1.2 Wildlife

Most of the wildlife at the Tuttle Creek Lake project can be divided into four groups, mammals, birds, reptiles, and amphibians. The area around Tuttle Creek Lake and downstream on the Big Blue River and Kansas River floodplains provides rich habitat for a variety of wildlife species. In these areas upland, riparian and aquatic habitats occur in close proximity with each other. This variety of habitat results in a wide variety of wildlife in the project area. Much of this wildlife is heavily dependant on the existing aquatic and riparian habitat that currently exists in the project area. This Section discusses the typical mammals, birds, reptiles and amphibians found in the project area. Fish will be discussed in Section 3.2.2 Aquatic Ecosystem (including wetlands and fisheries). Wildlife listed as Threatened and Endangered are discussed under 3.2.3 Threatened and Endangered Species.

USFWS in the CAR reports that mammals in the project area include terrestrial and aquatic furbearers that are important to the overall ecosystem and as an economic resource for the region. Furbearers dependent upon aquatic habitats include the beaver, mink and muskrat. Terrestrial furbearers include opossum, coyote, raccoon, and striped skunk. Important game animals include the white-tailed deer, mule deer, eastern cottontail, and fox squirrel.

USFWS in the CAR note that birds in the project area include permanent residents, summer residents, transients and winter residents. Of particular note are the numerous waterfowl that utilize Tuttle Creek Lake and adjacent wetland

1416 areas. Waterfowl use the area for nesting and rearing young during the summer
1417 months and in much larger numbers and variety during the fall, winter and spring
1418 during migration. Riparian areas in the project area provide important habitat to
1419 numerous passerine species including the rough-winged swallow, Bell's vireo,
1420 yellow warbler and common yellowthroat. Mudflats on the lake provide important
1421 migratory habitat for shorebirds.

1422
1423 A wide variety of reptiles and amphibians are found in the project area.
1424

1425 A complete description of wildlife resources in the project area is included in
1426 the USFWS-CAR, included as Appendix B. In addition, a list of typical wildlife
1427 found in the project area is included as Appendix C – Common Mammals, Birds,
1428 Amphibians, Reptiles and Fish of the Project Area.
1429

1430 **3.2.2 Aquatic Ecosystem (including wetlands & fisheries)**

1431
1432 The aquatic ecosystem in the project area is comprised of Tuttle Creek Lake,
1433 the Big Blue River, the Kansas River, and their tributaries and the adjacent
1434 wetland/riparian areas. Potential effects on the aquatic ecosystem were a primary
1435 concern of resource agencies and the community identified during scoping. As
1436 noted above, the area around Tuttle Creek Lake and downstream on the Big Blue
1437 River and Kansas River floodplains provides rich habitat for a variety of wildlife
1438 species. In these areas upland, riparian and aquatic habitats occur in close
1439 proximity with each other. This variety of habitat results in a wide variety of wildlife
1440 in the project area. Much of this wildlife is heavily dependent on the existing aquatic
1441 and riparian habitat that currently exists in the project area.
1442

1443 Extensive wetlands have developed at the upper end of Tuttle Creek Lake as
1444 silt and sediment has accumulated in areas that were once open water. These
1445 areas provide important habitat to fish and wildlife resources. In addition, these
1446 wetlands adjacent to Tuttle Creek Lake continue to trap additional sediment.
1447 Several marsh areas have been developed by KDWP on leased Wildlife
1448 Management Area lands at the upper end of Tuttle Creek Lake. Inflows and
1449 sediment are constantly influencing the open water, mudflat, and wetland habitat at
1450 the upper end of Tuttle Creek Lake. Wetlands on the Big Blue and Kansas River
1451 floodplain are fairly scarce, as many of these areas have been drained to facilitate
1452 agricultural production. In addition, the lack of out of bank flows, resulting from
1453 operation of the Kansas River system for flood control, has reduced or eliminated
1454 the hydrology needed to support many of these wetland areas. Wetland areas
1455 typically support the highest diversity and numbers of wildlife and are extremely
1456 important to mammals, birds, reptiles, amphibians, and fish in the project area.
1457

Fisheries resources in Tuttle Creek Lake include native and introduced species. The lake supports a wide variety of game and non-game fish. Typical fish at Tuttle Creek Lake include; large mouth bass, white bass, bluegill, flathead catfish, blue catfish, channel catfish, drum, carp, buffaloes, crappie, walleye, wipers, striped bass, and many others including forage fish and minnows.

On a yearly basis, the Corps in coordination with the Kansas Water Office enters into a Lake Level Management Plan. This plan is developed to maximize fish and wildlife benefits and recreation through minor seasonal variations in the pool level at Tuttle Creek Lake.

Aquatic vegetation is fairly scarce at Tuttle Creek Lake due to the widely fluctuating pool, high turbidity and extensive wind driven wave action. Wind driven waves result in substantial erosion when the Tuttle Creek pool is above the multipurpose pool elevation. High turbidity, a greatly fluctuation pool and substantial sedimentation all adversely affect the existing fishery resource at Tuttle Creek Lake.

KDWP operates a put and take trout fishery at River Pond State Park. Rainbow trout (*Oncorhynchus mykiss*) are stocked in the relief well collector ditch downstream of the dam. This program was initiated in 1994.

The Big Blue River extends approximately 9 miles downstream of Tuttle Creek Lake to its confluence with the Kansas River at river mile 147. Below Tuttle Creek dam the presence of Rocky Ford dam just 1 miles downstream influences the tailwater elevation in the Tuttle Creek stilling basin and in River Pond. Rocky Ford dam is practicably an impassable barrier to fish moving upstream from the lower Big Blue and Kansas Rivers. Fish populations above Rocky Ford dam and below Tuttle Creek dam are supported by natural reproduction within that area or from fish that move through the conduit from Tuttle Creek Lake. As a result of this movement, the River Pond, outlet and KDWP's Rocky Ford Dam & Fishing Area contain many more typical lake fish like walleye, saugeye, white bass, black crappie, wipers and stripers. Below Rocky Ford dam the Big Blue and Kansas Rivers support a fish population that is typical of the large turbid rivers. Common species of fish found in these waters would include common carp, gars, drum, buffaloes, gizzard shad, channel and flathead catfish.

On a yearly basis, the Corps in coordination with the Kansas Water Office enters into a Lake Level Management Plan. This plan is developed to maximize fish and wildlife benefits and recreation through minor seasonal variations in the pool level at Tuttle Creek Lake.

A list of typical fish found in the project area is included as Appendix C – Common Mammals, Birds, Amphibians, Reptiles and Fish of the Project Area. Fish listed as Threatened and Endangered are discussed under 3.2.3 Endangered Species.

3.2.3 Threatened and Endangered Species

3.2.3.1 Bald Eagle

The Federally listed threatened bald eagle (*Haliaeetus leucocephalus*) is commonly found in the study area, primarily during fall and winter when migrating birds utilize areas adjacent to Tuttle Creek Lake, the Big Blue River both upstream and downstream of Tuttle Creek Lake, and along the Kansas River for feeding and resting. Large trees, i.e. typically greater than 12 inches in diameter at breast height, adjacent to these waterbodies, are used by bald eagles for night roosts, resting and hunting perches. Movement of bald eagles into the study area in the fall is typically concurrent with the arrival of migratory waterfowl and bald eagles typically remain in the area as long as there is open water available on the lake or areas downstream. Bald eagles typically move back through the area when migratory waterfowl move north to their nesting grounds. There have been several practice nests built over the last 10 years at Tuttle Creek Lake and in the CAR the USFWS reported that there were currently two active bald eagle nests adjacent to the upstream areas of Tuttle Creek Lake. One of these nests successfully hatched chicks in 2002. The Kansas River had two active/successful bald eagle nest during 2001, both of these nests were located downstream in the Lawrence to Lecompton reach. No critical habitat has been identified for the bald eagle. The bald eagle is currently proposed for de-listing from protection under the Endangered Species Act. Although de-listing is a possibility in the near future, the bald eagle is still protected under several other Federal laws.

The USFWS in the Missouri River, Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System (Biological Opinion), stated that the Corps' proposed operation of the Missouri River Main Stem Reservoir System, the Bank Stabilization and Navigation Project, and the Kansas River Reservoir System, which includes Tuttle Creek Lake, are not likely to jeopardize the continued existence of the Federally-listed threatened bald eagle. The USFWS included Conservation Recommendations in their opinion to assist the Corps in decreasing long term impacts of system operation on the bald eagle to help carry out programs for the conservation of the species.

3.2.3.2 Interior Least Tern

The interior least tern (*Sterna antillarum athalassos*) was Federally listed as endangered in 1985. No historic records of least terns nesting on the mainstem Kansas River exist. The species was first observed nesting on the Kansas River in 1996 at approximately river mile 131.0. Colonies or individual pairs have continued nesting each year in the middle river, approximately river mile 65.0 to 140.0, most frequently from approximately river mile 75.0 to 130.0. Birds have relocated and used different sandbars throughout this time period in response to revegetation of sandbar habitats. Nesting interior least tern populations on the Kansas River have remained relatively small since their discovery in 1996. The high count was 18

nesting pairs in 1998. Nest success has varied a great deal, including 1999 when not a single chick was fledged due to uncontrolled runoff from rainfall events, which destroyed all nests. Since 1994, a small (less than 10 pairs) nesting colony has been established at the Jefferson Energy Center, located 7 miles north of river mile 113 in Pottawatomie County. Interchange likely occurs between that colony and those on the Kansas River, as indicated by the 2000 recapture on the Kansas River of an adult interior least tern which had been banded as a nesting adult in 1999 at the Jefferson Energy Center. There are no records to indicate that interior least terns utilize the Blue River upstream of Tuttle Creek Lake, Tuttle Creek Lake, or the Blue River between the dam and the confluence with the Kansas River. No critical habitat has been identified for the interior least tern.

Since 1998, the Corps in consultation with the U.S. Fish and Wildlife Service has operated Tuttle Creek Lake to prevent the loss of interior least tern eggs and/or chicks. This has resulted in pools above the multipurpose pool elevation of 1,075 ft., m.s.l. during summer months. Occasionally the pool has risen up to 1,085 ft., m.s.l. By holding this water in Tuttle Creek Lake, downstream flooding and loss of interior least tern and piping plover eggs & chicks has been prevented. Inflow that cannot be controlled by the Corps lake projects often times results in inundation and loss of interior least tern and piping plover eggs and chicks.

The USFWS in the Missouri River, Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System. November 30, 2000, stated that the Corps' proposed operation of the Missouri River Main Stem Reservoir System, the Bank Stabilization and Navigation Project, and the Kansas River Reservoir System, which includes Tuttle Creek Lake, are likely to jeopardize the continued existence of the Federally-listed endangered interior least tern. No critical habitat has been identified for the interior least tern. In this opinion the USFWS also provided the Corps with Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take, and Conservation Recommendations that include actions for the interior least tern, piping plover, pallid sturgeon and the ecosystem in general that USFWS believes will avoid all likelihood of jeopardizing the continued existence of the three species. One measure recommended by USFWS in the Biological Opinion is to gather data and determine if the Kansas River provides a source or sink for the interior least tern. A determination on this is scheduled for 2005. Depending on the outcome, existing operations could be continued or curtailed.

3.2.3.3 Piping Plover

The piping plover (*Charadrius melodus*) was Federally listed as threatened in 1985. The first known breeding record for the piping plover on the Kansas River occurred in 1996 when two pairs of plovers nested on sandbar habitat. This habitat was on a new channel created by the high water in 1993. The new nesting in Kansas on the Kansas River is a southern extension of their breeding range. Success of piping plovers since the initial 1996 nesting has been tenuous. Because

much of the flow in the Kansas River has been controlled since the 1950s, sandbar habitat is usually not available for plovers. The importance of the Kansas River for piping plovers is virtually unknown. There are no records to indicate that piping plovers utilize the Tuttle Creek Lake or the Blue River between the dam and the confluence with the Kansas River.

The USFWS in the Missouri River, Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System. November 30, 2000, stated that the Corps proposed operation of the Missouri River Main Stem Reservoir System, the Bank Stabilization and Navigation Project, and the Kansas River Reservoir System, which includes Tuttle Creek Lake, are likely to jeopardize the continued existence of the Federally-listed threatened piping plover. No critical habitat has been identified for the piping plover. In this opinion the USFWS also provided the Corps with Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take and Conservation Recommendations that include actions for the interior least tern, piping plover, pallid sturgeon and the ecosystem in general that USFWS believes will avoid all likelihood of jeopardizing the continued existence of the three species. One measure recommended by USFWS in the Biological Opinion is to gather data and determine if the Kansas River provides a source or sink for the piping plover. A determination on this is scheduled for 2005. Depending on the outcome, existing operations could be continued or curtailed.

3.2.3.4 Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) was not recognized as a distinct species until 1905. The pallid sturgeon was Federally listed as endangered in 1990. There are no records to indicate that pallid sturgeon have ever occurred in the Blue River or Tuttle Creek Lake. Historic catch records for the pallid sturgeon are scarce for the Kansas River. Since 1950s, only five documented pallid sturgeon have been sampled from the lower 40 miles of the Kansas River, all during late March and early April in 1952. Pallid sturgeon inhabit the mainstem Missouri River, and have entered the lower Kansas River during floods, with the furthest upstream records from Douglas County. USFWS report that it is highly unlikely that the pallid sturgeon currently occurs in the Kansas River due to habitat modifications and physical barriers (e.g. Johnson County Weir), except under conditions of high flows.

The USFWS in the Missouri River, Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System. November 30, 2000, stated that the Corps proposed operation of the Missouri River Main Stem Reservoir System, the Bank Stabilization and Navigation Project, and the Kansas River Reservoir System, which includes Tuttle Creek Lake, are likely to jeopardize the continued existence of the Federally-listed endangered pallid sturgeon. No critical habitat has been identified for the pallid sturgeon. In this opinion the USFWS also provided the Corps with Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to

Minimize Take and Conservation Recommendations that include actions for the interior least tern, piping plover, pallid sturgeon and the ecosystem in general that USFWS believes will avoid all likelihood of jeopardizing the continued existence of the three species.

3.2.3.5 State Listed Species

In addition to those Federally listed threatened and endangered species listed above, the State of Kansas maintains a list of threatened and endangered species in Kansas. Included in Appendix D are the State listed threatened and endangered species and critical habitat that are found in Riley and Pottawatomie Counties, Kansas

3.3 Socio-Economic Environment

3.3.1 Demography

Utilizing the 1990 and 2000 census data, the demography of the study area shows the greatest increases in population associated with the towns/cities located on the western edge of the Kansas City metropolitan area including Eudora (43.1%) and Lawrence (21.4%). Smaller increases in population occurred at Manhattan (4.1%), Topeka (1.3%), St. George (9.3%), and Wamego (13.1%). Minor decreases in population were found at Lecompton (-2.4%) and Willard (-21.8%). Comparing the population for counties in the study area, again most of the counties near the Kansas City metropolitan area saw the biggest increases with Johnson (27.0%), Leavenworth (6.7%), Jefferson (15.9%) and Douglas (22.2%) and a minor decrease in Wyandotte (-2.5). In the Manhattan area, Riley County had a decrease in population of -6.4%, while Pottawatomie had an increase of 12.9%. Overall, counties in the study area had a 13.3% increase in population, compared with the State of Kansas which had an 8.5% increase in its population to 2,688,418.

3.3.2 Development and Economy

The study area is geographically comprised primarily of agricultural ground on the uplands surrounding Tuttle Creek Lake and on the floodplains of the Kansas and Big Blue Rivers. Located along the Kansas River floodplain are several small to medium size towns/cities that serve the surrounding areas as trade centers and provide employment opportunities for individuals not directly involved in agricultural production. At the eastern terminus of the Kansas River are the extensively urban and industrial areas associated with Kansas City. The economy is dominated by agriculture in the rural areas near Manhattan, Topeka, Lawrence and extending to the fringes of the Kansas City Metropolitan area in Johnson & Wyandotte Counties. Development associated with the Kansas City metropolitan area is becoming much more evident in Lawrence and areas to the east. While some areas in Johnson and Wyandotte Counties have traditionally been heavily urbanized, increasing urbanization and an economy less dominated by agricultural production is becoming apparent in Leavenworth, Douglas and Jefferson Counties. Looking at median household income figures from 1997 shows the highest figures typically associated

with most heavily urbanized counties, Johnson (\$59,870), Leavenworth (\$44,056), Jefferson (\$41,130), Shawnee (\$40,122). Wyandotte County, which includes some of the longest established area within the urban core, had a 1997 median household income of \$30,056. Counties in the Manhattan area include Riley (\$33,744), Pottawatomie (\$38,587) and Wabaunsee (\$36,802). The 1997 median household income for the State of Kansas was \$36,488.

With agricultural production a dominant part of the study area economy, a review of the 1997 United State Department of Agriculture-Census of Agriculture reports that in the State of Kansas overall land in farms decreased 1 percent from 46,672,188 acres in 1992 to 46,089,268 acres in 1997. During this same time period the average size of a farm in Kansas increased 1 percent from 738 acres to 748 acres. Full time farms decreased 11 percent from 39,324 to 34,979. The market value of agricultural products sold in the State of Kansas increased 11 percent from 1992, to \$9,207,130,000. Crop sales accounted for 35 percent of the market value with livestock sales comprising 65 percent.

3.3.3 Land Use

As described above in 3.3.2 Development and Economy the land in the study area is dominated by agricultural use. In addition, some upstream areas adjacent to Tuttle Creek Lake have been developed as residential areas. Residents in these developments place a high value on the view of Tuttle Creek Lake and adjacent natural areas and their close proximity to recreational opportunities associated with Tuttle Creek Lake. Immediately downstream on the floodplains of the Big Blue and Kansas Rivers are developed residential and business areas within the City of Manhattan. The City of Manhattan covers an area of approximately 11 square miles and has an estimated population of 44,831.

3.3.4 Public Safety

A complete description of the existing conditions that affect public safety at Tuttle Creek Lake are included in Section 6. of the FEvR. Section 7.03 of the FEvR provides a complete description of the damages that would be associated with a dam failure at Tuttle Creek Lake including potential property damage and probable loss of human life. Potential effects on public safety were a primary concern of local government, state agencies and the community identified during scoping.

3.3.5 Transportation

The study area is serviced by an extensive road transportation system including Interstate, U.S. Route, State Route, City, County and Township roads. The Kansas Department of Transportation (KDOT) provided the following Fiscal Year 2001 Average Annual Daily Traffic (AADT) counts for the major Federal and State roads in the study area.

The primary east-west Interstate transportation route that dominates the study area is Interstate 70 (I-70). I-70 crosses the State of Kansas, passes approximately 8 miles south of Manhattan and basically parallels the Kansas River to the eastern terminus of the study area at Kansas City. I-70 passes through Topeka, Lawrence and Kansas City. In the study area vehicle traffic on I-70 is fairly heavy with large numbers of heavy commercial vehicles. I-70 in the study area is typically a 4-lane divided blacktop with improved shoulders and limited access.

In addition, U.S. Route 24 parallels the Kansas River and I-70 across the study area running through Manhattan, Topeka, Lawrence and Kansas City. U.S. Route 24 is typically a 2-lane blacktop with at grade access in the study area. Estimated daily traffic counts for U.S. Route 24 at Manhattan are 11,215 vehicles per day of which approximately 725 would be considered heavy commercial.

With Interstate 135 to the west of the study area at Salina and Interstate 35 running through the eastern terminus of the study area at Kansas City, U.S. Route 77 which passes just west of Manhattan and runs along the western edge of Tuttle Creek Lake, U.S. Route 75 which passes through Topeka, and U.S. Route 59 which passes through Lawrence are the primary north-south transportation routes in the project area. These routes are typically a 2-lane blacktop with at grade access in the study area

In the immediate project area, State Route 13 crosses the Big Blue River on the crest of Tuttle Creek dam. Estimated average daily vehicle counts for this roadway across the dam are 5,280 vehicles per day of which 365 would be considered heavy commercial. The road is a 2-lane blacktop with at grade access. State Route 13 is an important route for residents in rural areas and surrounding towns located to the east and north of Manhattan to access the area. In addition, State Route 13 provides project visitors from the Manhattan area with access to recreational areas on the east side of the lake. Another east-west route in the immediate project area is State Route 16, which crosses Tuttle Creek Lake near Randolph. The road is a 2-lane blacktop with at grade access.

3.3.6 Navigation

One of the Congressionally authorized project purposes of Tuttle Creek Lake is to provide navigation support. The authority to use storage in the lake to support navigation is the 1954 Flood Control Act, Public Law 83-780. Support of navigation is identified in the authorizing legislation as an "interim" use of the lake. This interim period extends from the time the lake was completed until such time as a "permanent" purpose displaces the interim use. The purposes that can displace this use include municipal and industrial water supply, water quality, and sediment.

Three lakes in Kansas, Tuttle Creek, Milford and Perry, can be used to supplement Missouri River flow by as much as 4,000 cubic feet per second (cfs) up to the Kansas City navigation target. The normal navigation season at Kansas City typically opens on March 28 and closes on November 27, requiring 41,000 cfs for full service and 35,000 cfs for reduced service. The Kansas Lake Regulation

Manual states that “During designated periods, minimum permissible pool levels for adequate recreation and reasonably stable or slowly rising pool levels for fish spawning will supersede navigation requirements except during unusual circumstances.” The minimum pool levels established for Tuttle Creek Lake are elevation 1,072.0 ft., m.s.l. before October 1, and elevation 1,069.0 ft., m.s.l. after October 1.

Tuttle Creek is rarely required to release water to support navigation. Since the multipurpose pool elevation was reached in 1963, Tuttle Creek has been called into service to support navigation in only 4 years, 1988, 1989, 1991 and 2000. The estimated annual benefits of navigation support from Tuttle Creek Lake are \$2,659,000 (Oct. 2001 values).

In the Fall of 2000, the State of Kansas initiated a lawsuit against the U.S. Army Corps of Engineers alleging that the Corps lacked the authority to support Missouri River navigation with releases from Tuttle Creek Lake. The complaint was later withdrawn, before the court could make a final ruling.

3.3.7 Utilities/Water supply

One of the Congressionally authorized project purposes of Tuttle Creek Lake is water supply. Approximately 50,000 acre-feet of water in the multipurpose pool is available to be used as water supply to downstream users. A complete description of the Kansas Water Office’s project sponsor relationship and cost sharing responsibilities is included above in Section 1.8 Project Sponsor, additional description of water supply benefits are included in Section 7-04.d. of the FEvR. Potential effects on water supply was a primary concern of State resource agencies identified during scoping.

The Kansas Department of Agriculture-Division of Water Resources reports that there are a total of 40 authorized surface water diversions from the Kansas River downstream of Tuttle Creek Lake. Designated uses of this water include: municipal (11), industrial (12), recreation (2), hydraulic dredging (2) and irrigation (13). The Kansas River is an important source of water for several major municipalities along the river including: the cities of Topeka, Lawrence, Olathe and areas serviced by Johnson County Water District #1. Kansas River water also is used to cool several major power plants that are located along the Kansas River.

At Tuttle Creek Lake, the Blue Valley Telephone Company’s fiber optic cable crosses the Big Blue River 1/4 mile downstream of Blue Rapids, and the National Co-Op Refinery Association’s gasoline line that crosses the river 1/4 mile upstream of Blue Rapids. In addition, the University Park development’s sewer outfall discharges to the lake. Both the University Park and Blue River Hills developments adjacent to the lake utilize groundwater wells.

The City of Manhattan uses groundwater as its source of drinking water. The city has 16 wells that pump groundwater to the water treatment plant. These wells are located on the floodplain just landward of the Manhattan Levee. Normally, 5.5 million gallons of wastewater flows through the Manhattan Wastewater Treatment Plant (WWTP) each day. The WWTP uses a series of treatment stages to treat the wastewater so that it may be safely released to the Kansas River.

3.3.8 Flood control

One of the Congressionally authorized project purposes of Tuttle Creek Lake is flood control. A detailed description of the flood control benefits associated with Tuttle Creek Lake is included as Section 7-04.b. of the FEvR. Potential effects on the flood control was a primary concern of State and local governments and the community identified during scoping. Tuttle Creek Lake is one of 7 Corps and 10 Bureau of Reclamation lakes on tributaries of the Kansas River. The flood control pools of these lakes are operated by the Corp. Tuttle Creek Lake, with its location on the Big Blue River, provides a major amount of the flood control on the Kansas River system. The Kansas River Basin encompasses 52,945 contributing square miles. The Big Blue River basin above Tuttle Creek dam encompasses 9,628 square miles or approximately 18 percent of the total Kansas River basin. The Big Blue River basin upstream of Tuttle Creek Lake includes areas in the north central Kansas and south central Nebraska.

Federal flood reduction projects located downstream of Tuttle Creek Lake include levees on the Kansas River Levee System and the Missouri River Levee System. In addition, there are numerous levee systems on the Kansas River floodplain that provide lower levels of protection and are typically constructed and maintained by local levee districts to a level sufficient to qualify for participation in the P.L. 84-99 program.

3.3.9 Recreation

The total acreage for the Tuttle Creek Lake project including the lake and surrounding lands owned in fee is 33,574 acres. Land at Tuttle Creek Lake project is divided into three categories, project operations, recreation, and multiple resource management. A detailed description of the recreation benefits associated with Tuttle Creek Lake is included as Section 7-04.c. of the FEvR. Potential effects on recreation at Tuttle Creek Lake were a primary concern of resource agencies and the community identified during scoping. Approximately 441 acres of land are classified as project operations. This designation includes lands acquired and allocated to provide for safe, efficient operation of the project for those authorized purposes other than recreation and fish and wildlife. This includes those land required for the structure, operations center, office, maintenance compound, and other areas that are used solely for project operations. Agricultural use of these lands are permitted on an interim basis when not in conflict with use for authorized purposes, recreation use, or wildlife habitat.

Approximately 3,062 acres of land are classified as recreation use. This designation includes land developed for intensive recreational activities by the visiting public, including developed recreation areas and areas for concession and quasi-public development. No agricultural uses are permitted on these lands except on an interim basis for terrain adaptable for maintenance of open space and/or scenic values.

Recreation areas at Tuttle Creek Lake have been developed in coordination with other Federal, state, and local community interests to provide broad based water-oriented recreational opportunities within the immediate area to the general public. Present recreational demands include camping, fishing, swimming, boating, picnicking, hiking, biking, horseback riding, and scenic, open space enjoyment. Public needs determine the type and level of development of recreation areas to insure that the maximum recreational benefits are available to the greatest number of people consistent with the principles of sound environmental management. No hunting is permitted in developed public use areas.

The Corps of Engineers manages six public use areas at the lake totaling 1,253 acres. These areas include:

Outlet	277 acres
Tuttle Creek Off-Road Vehicle Area	310 acres
Stockdale	188 acres
Tuttle Creek Cove	337 acres
Observation Point	76 acres
Spillway Cycle Area	65 acres

Recreation development in these areas include facilities such as boat launching ramps, a courtesy dock, a shower-latrine building, a trailer sanitary dump station, parking areas, picnic tables, a swimming beach, camping sites, and playground equipment.

The State of Kansas manages four public use areas at the lake totaling 1,166 acres. These areas include:

Fancy Creek State Park	372 acres
Randolph State Park	202 acres
Spillway State Park	153 acres
River Pond State Park	439 acres

Pottowatomie County manages a public use area of 245 acres.

Major development is oriented toward camping and its associated facilities. Water oriented activities have been enhanced by development of a concession marina in the state park areas.

1927
1928 Six quasi-public organizations presently license land, totaling 398 acres, at
1929 Tuttle Creek Lake for recreation purposes. These organizations include:

1930		
1931	Blue Valley Yacht Club	10 acres
1932	Riley County Fish and Game Association	62 acres
1933	Kansas Association of Seventh Day Adventist	268 acres
1934	Living Waters Ranch	21 acres
1935	Kansas State University Rowing Club	23 acres
1936	Riley County Radio-Controlled Fliers	14 acres

1937
1938 Quasi-public use of project lands is limited to organizations with a unique
1939 group requirement, who service a certain segment of the public and who possess
1940 adequate financial and managerial capabilities to realize stated and approved
1941 objectives. Leases to quasi-public groups may be terminated for non-compliance
1942 with terms or conditions of the real estate lease.

1943
1944 Approximately 14,331 acres of land are classified as multiple recreation use.
1945 This designation is made up of land managed for wildlife management and low-
1946 density recreation.

1947
1948 Approximately 12,030 acres are classified as wildlife management land. This
1949 designation includes land acquired for project operations and allocated as habitat
1950 for fish and wildlife or for propagation of such species. The land in this allocation is
1951 leased to the Kansas Department of Wildlife and Parks.

1952
1953 Approximately 2,301 acres are classified as low-density recreation. Low-
1954 density recreation includes activities such as hiking, primitive camping, wildlife
1955 observation, hunting, or similar activities.

1956
1957 There were approximately 2,831,000 visitor hours at the Tuttle Creek Lake
1958 project in 2000. The visitation included various recreational activities such as
1959 camping, fishing, picnicking, boating, swimming, and hunting. These recreational
1960 activities are discussed below.

1961 1962 **3.3.9.1 Hunting**

1963
1964 Hunting is allowed on most of the land at Tuttle Creek Lake. Almost 18,000
1965 acres of land is available for public hunting. The developed parks and the entire
1966 area below the dam are closed to hunting. A posted refuge in the Shannon Creek-
1967 Swede Creek area is closed to hunting (and all other activities) from October 1 to
1968 January 15.

1969
1970 The majority of the land open to hunting is classified as wildlife management
1971 land. This area is located at the upper (north) end of the project. Access to the
1972 land open for hunting is fair to good. The access is over county and township
1973 roads. Most of the access roads are gravel with a few being paved and some being
1974 unimproved (dirt).

Most of the land designated for hunting is bottomlands. The bottomlands consisting of cropped and wooded areas. Wetlands are located throughout the bottomlands. The upland areas are steep and hilly, covered with prairie grass and trees.

Typical game species that can be found at Tuttle Creek Lake include:

Rabbits	Wild Turkey
Squirrels	Deer
Pheasants	Opossum
Quail	Raccoon
Ducks	Striped Skunk
Geese	

KDWP has constructed six manmade marsh areas on leased Wildlife Management Area lands at Tuttle Creek Lake. These marshes provide good duck hunting areas and important wildlife habitat. These include Irving Marsh, Black Vermillion Marsh, Timber Creek Marsh, Swede Creek Marsh, and Fancy Creek Marsh.

3.3.9.2 Fishing

In 2000, approximately 61,000 people visited the Tuttle Creek Lake project for the purposes of fishing. This is approximately nine percent of the total visitation to the project.

The last creel survey conducted at the project by the Kansas Department of Wildlife and Parks was for the dates of March 1 through October 31, 1998. The survey was conducted at the Tuttle Creek River Pond and Rocky Ford. While Rocky Ford is not within the project boundaries, the data from this location has been included due to the close proximity to the project (less than one mile). The Kansas Department of Wildlife and Parks has not conducted a creel survey of the main lake since 1974. Due to the amount of time that has past since the 1974 survey, the data from that survey has not been included in this FEIS. It does not represent the current conditions at the lake.

The 1998 survey indicated that from March 1 through October 31, there were 27,767 anglers fishing at the Tuttle Creek River Pond and they fished for a total of 40,222 hours. There were 16,173 anglers at Rocky Ford and they fished for a total of 21,125 hours. The following is the type and number of fish caught at each location:

Species	Estimated Number of Fish Harvested		Estimated Number of Fish Released		Estimated Total Fish Caught	
	River Pond	Rocky Ford	River Pond	Rocky Ford	River Pond	Rocky Ford
Largemouth bass	55	18	54	18	109	36
Channel catfish	3,702	1,087	2,540	377	6242	1464
Bluegill	33	0	45	38	78	38
Black crappie	11	89	542	25	553	114
White crappie	25,789	3,691	6,843	761	32632	4452
Paddlefish	0	0	0	134	0	134
Longnose gar	44	38	11	526	55	564
Shortnose gar	0	0	0	38	0	38
Rainbow trout	3,116	0	143	0	3259	0
Common carp	183	38	553	231	736	269
Bigmouth buffalo	50	0	69	66	119	66
Smallmouth buffalo	16	13	22	13	38	26
Flathead catfish	266	48	200	30	466	78
White bass	1,078	2,298	954	1,543	2032	3841
Saugeye	502	311	4,274	2,618	4776	2929
Drum	76	547	451	1,314	527	1861
Black bullhead	0	0	0	18	0	18

2039 The following is the type of fish caught at each location, by weight:
 2040

Species	Estimated Weight of Fish Harvested (lb)		Estimated Weight of Fish Released (lb)		Estimated Total Weight of Fish Caught (lb)	
	River Pond	Rocky Ford	River Pond	Rocky Ford	River Pond	Rocky Ford
Largemouth bass	68.8	35.4	42.3	10.1	111.1	45.5
Channel catfish	6429.8	1292.6	1258.9	211.6	7688.7	1504.2
Bluegill	11.7	0.0	5.4	6.9	17.1	6.9
Black crappie	5.4	31.2	89.3	2.3	94.7	33.5
White crappie	15745.3	1978.6	1216.8	115.3	16962.1	2093.9
Paddlefish	0.0	0.0	0.0	339.0	0.0	339.0
Longnose gar	138.6	138.8	12.4	1056.0	151.0	1194.8
Shortnose gar	0.0	0.0	0.0	122.7	0.0	122.7
Rainbow trout	2048.0	0.0	87.1	0.0	2135.1	0.0
Common carp	916.7	173.7	2722.6	608.3	3639.3	782.0
Bigmouth buffalo	327.3	0.0	212.4	61.5	539.7	61.5
Smallmouth buffalo	95.0	59.1	152.8	116.5	247.8	175.6
Flathead catfish	1813.0	173.7	799.0	37.3	2612.0	211.0
White bass	856.3	1611.9	768.8	409.4	1625.1	2021.3
Saugeye	929.0	388.7	3309.5	1163.8	4238.5	1552.5
Drum	87.3	551.8	483.0	896.0	570.3	1447.8
Black bullhead	0.0	0.0	0.0	3.7	0.0	3.7

2041
 2042
 2043 The following is the type and number of fish caught per angler hour at each
 2044 location:
 2045

Species	Estimated Number of Fish Caught per Angler Hour	
	River Pond	Rocky Ford
Largemouth bass	0.0027	0.0017
Channel catfish	0.1552	0.0693
Bluegill	0.0019	0.0018
Black crappie	0.0137	0.0054
White crappie	0.8113	0.2107
Paddlefish	0	0.0063
Longnose gar	0.0014	0.0267
Shortnose gar	0	0.0018
Rainbow trout	0.0810	0
Common carp	0.0183	0.0127
Bigmouth buffalo	0.0029	0.0031
Smallmouth buffalo	0.0009	0.0012
Flathead catfish	0.0116	0.0037
White bass	0.0505	0.1818
Saugeye	0.1187	0.1386
Drum	0.0131	0.0881

2046
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KDWP has operated a put and take trout fishery in the relief well collector ditch system in River Pond State Park since 1994. Rainbow trout noted above are from this operation.

During the 1998 creel survey, the anglers were interviewed as to what species of fish they were trying to catch. The following is a list of species sought by percentage:

Species	Percent of Anglers Seeking Species	
	River Pond	Rocky Ford
Channel catfish	25.0	31.9
Flathead catfish	8.6	3.7
Black bass	0.6	0.3
White bass	3.1	15.4
Walleye (percid)	7.3	22.4
Wiper	0	0.1
Crappie	36.5	16.5
Bluegill	0.1	0.2
Carp	1.4	0
Drum	0.1	0.6
Any	3.9	10.0

3.3.9.3 Boating

The public boating facilities at Tuttle Creek Lake include thirteen boat ramps, four courtesy docks, and one concession marina. The marina, Big Dawg Marina, is located at Spillway State Park. This marina is operated under a 25-year lease, ending in 2015, with the Kansas Department of Wildlife and Parks. The facilities and services at the marina include 40 covered slips, 5 uncovered slips, boat and motor rental and repair, boat, tackle, grocery, and fuel sales, and snack bar. The marina is open April 15th through October 15th. The Spillway Marina has been heavily damaged by high water or wind and wave action on several occasions due to the cove in which the marina is located being open to the west and subject to storms which generally approach from that direction.

A boat rental facility, Kansas River Outfitters, is located in the River Pond State Park. Kansas River Outfitters provide canoe, paddleboat, and pontoon boat rentals, boat, fishing equipment, and grocery sales, firewood, campfire catering, and offer a guide service for float trips on various rivers.

The public boat ramps at Tuttle Creek Lake vary in size from 2-lane to 4-lane and consist of a concrete apron extending into the lake. Since the concrete aprons extend into the lake, a minimum lake level must be maintained for the boat ramps to be usable. The following is the minimum lake elevations needed to keep the various boat ramps usable (all elevations are listed in feet above sea level):

Fancy Creek State Park	1,080*
Randolph State Park	1,080*
Spillway State Park	1,061
Stockdale (Lower)	1,070
Stockdale (Upper)	1,069
Mill Cove	1,069
Tuttle Creek Cove	1,061
Carnahan	1,072

* The minimum usable boat ramp elevations for Fancy Creek and Randolph State Parks were originally 1,069 ft., m.s.l. but have been silted in to approximately 1,080 ft., m.s.l.

The boat ramp at River Pond State Park is not affected by a minimum lake elevation because it is located below the dam. Drawdowns of Tuttle Creek Lake have a minimal effect on the water elevation in River Pond.

The Blue Valley Yacht Club and sailboat facilities are located in Tuttle Cove. The Kansas State University rowing team practices in the area along the upstream face of the dam from an access point located near Spillway State Park.

Approximately 46,000 visitors participated on boating recreation at Tuttle Creek Lake in 2000. This is approximately seven percent of the total visitation to the lake. The lake is used by various watercrafts including fishing boats, ski boats, pontoon boats, sailboats, and personnel water craft (jet skis).

3.3.9.4 Swimming

There are two developed swimming beaches at Tuttle Creek Lake. One is located at Tuttle Creek Cove and includes a buoyed swimming area, two changing houses, one outdoor shower, one sand volleyball court, and a playground. The other swimming beach is located in River Pond State Park. It contains a buoyed swimming area, one bathhouse and sand and mud volleyball court.

A mile-long natural sand beach is located on the east side of the lake adjacent to Broken Arrow Ranch. Access to the beach by vehicle is difficult due to a steeply rutted abandoned road. Access to this beach is still possible by foot or boat. There are no developed facilities at this natural beach.

3.3.9.5 Camping/Hiking

Tuttle Creek Lake has seven developed camping areas. Two are maintained by the Corps of Engineers, Stockdale and Tuttle Creek Cove. Four are maintained by the Kansas Department of Wildlife and Parks, River Pond State Park, Spillway State Park, Randolph State Park, and Fancy Creek State Park. Pottawatomie County maintains the last developed camping area, Carnahan Creek. Camping at the project is permitted only in designated campgrounds. Primitive camping on the undeveloped parts of the project is prohibited due to the absence of sanitary facilities. The Tuttle Creek Wildlife Area has 11 primitive Campsites that are available.

All campgrounds contain level campsites, with picnic tables, grills, and fire rings. Shower and waterborne toilets are located in most parks.

The Stockdale campground has 12 developed camping units. There are water spigots, a shower house, a dump station, and a boat ramp at the campground.

The Tuttle Creek Cove campground has 24 camping units and six walk-in campsites. There are water spigots, a comfort station, swimming beach, playground, boat ramp, and courtesy dock.

The River Pond State Park has 193 developed camping units. 104 of the units have electric and water hookups. There are a stationary dump station, two shower houses, water spigots, playground, 18 picnic shelters, three boat ramps, two courtesy docks, a fishing dock, a fish cleaning station, a swimming beach and bath house, and a nature trail. All of the area downstream of Tuttle Creek Dam is included in the River Pond State Park and has been designated by the Kansas Department of Wildlife and Parks as National Park Service Land & Water Conservation Fund 6(f) property. The Dam Safety Assurance Program project will be coordinated with the Kansas Department of Wildlife and Parks such that full compliance with Land and Water Conservation Fund regulations is maintained.

The Spillway State Park has random camping sites. There is a shower house, water spigot, seven picnic shelters, a courtesy dock, a fish cleaning station, a large boat ramp, and marina.

The Randolph State Park has random camping sites. There is a shower house, water spigots, a dump station, five picnic shelters, a high water ramp, and hiking/equestrian trails.

The Fancy Creek State Park has 12 developed camping units. Each unit has electric hookups. There are vault toilets, ten picnic shelters, and a hiking trail. Currently, this campground does not have water. Two boat ramps are located at Fancy Creek State Park but are silted in and usable only a high lake levels.

The Carnahan Creek Park has three camping units. There are vault toilets, a picnic shelter, a boat ramp, and hiking/equestrian trails. Currently, this campground does not have water.

Approximately 117000 people visited Tuttle Creek Lake in 2000 to camp. The majority of these people camped at the River Pond State Park. The following is a breakdown of the number of visitors camping at each park:

Stockdale	2,381
Tuttle Creek Cove	1,683
River Pond State Park	110,000 (KDWP figures)
Spillway State Park	1,215
Randolph State Park	0
Fancy Creek State Park	1,263
Carnahan Creek	0

Tuttle Creek Lake has many miles of hiking, bicycling, and equestrian trails. Trails are located in six of the developed parks.

The Blue River Trail in Outlet Park is the most popular hiking trail. It is an interpretive one-mile loop located on the east side of the Blue River. Excellent views of wildlife can be had in all seasons. A spur trail leads to a wildlife viewing blind situated on a beaver pond.

The Cedar Ridge Trail is located in Spillway State Park. It is an ADA accessible hiking trail and is the Coalition for Recreational Trails National ADA Trails Award winner for 2001. Scenic views and interesting landscapes can be seen from this half-mile trail. It is located east of the boat ramp and has ADA accessible restrooms at the trailhead.

A quarter-mile nature trail is found in River Pond State Park. This trail is adjacent to the River Pond campground and has educational information stations along it.

Two trails are located in Fancy Creek State Park. A two-mile hiking trail goes through wooded ravines and hillsides. A more rugged four-mile mountain bike and hiking trail is also located in Fancy Creek State Park. This trail goes through dense cedar forest into open native grassland and runs along rocky ridges with scenic overlooks.

A 14-mile hiking/equestrian trail is located in Randolph State Park. This trail goes through a variety of terrain and vegetation types.

A five-mile hiking/biking/equestrian trail is located in Carnahan Creek Park. Scenic vistas and wildlife can be seen from this trail.

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3.3.9.6 Picnicking

Picnic facilities are available at every park except the Tuttle Creek Off-Road Vehicle Area. Fifty picnic shelters are located throughout the various parks. Numerous picnic tables are also located throughout all parks except the Tuttle Creek Off-Road Vehicle Area.

Over 46,000 picnic visits occurred at Tuttle Creek Lake in 2000. This is approximately nine percent of the total visitation to the lake. The following is the number of visits at each park:

Outlet	24,328
Stockdale	2,781
Tuttle Creek Cove	4,551
River Pond State Park	6,199
Spillway State Park	4,293
Randolph State Park	345
Fancy Creek State Park	1,208
Carnahan Creek	586
Observation Point	1,854
Spillway Cycle Area	0
Tuttle Creek Off-Road Vehicle Area	0

As the above list indicates, the picnic facilities at the Outlet Park are the most heavily used. Six picnic shelters are located at the Outlet Park. Nearly all of these have a sand volleyball court, fire rings and picnic grills, and picnic tables. The following is a list of the equipment at the Outlet Park picnic shelters:

Pfeil Creek Shelter	Shelter #2
10 picnic tables	12 picnic tables
1 large grill	1 large grill
1 food service platform	1 fire ring with grill
1 fire ring with 3 benches	1 cutting board
3 trash cans	1 water fountain
2 vault toilets	1 volleyball court
1 volleyball court	3 trash cans
1 horseshoe court	Lights
1 softball field with backstop	Electrical outlets
	Playground nearby

2251		
2252	Cottonwood Shelter	Shelter #3
2253	16 picnic tables	13 tables
2254	2 large grills, 1 small grill	1 fire ring with grill
2255	1 fire ring with grill	2 large grills
2256	2 cutting boards	6 trashcans
2257	6 trash cans	2 vault toilets
2258	1 water faucet	1 jungle gym set
2259	1 volleyball court	1 volleyball court
2260	Lights	1 basketball half court
2261	Electrical outlets	1 water fountain
2262	Playground nearby	1 softball field w/backstop
2263		
2264	Shelter #1	Shelter #4
2265	7 picnic tables	13 tables
2266	1 large grill	2 large grills
2267	6 trash cans	1 cutting board
2268	1 volleyball court	1 fire ring with grill
2269	Playground nearby	5 trash cans
2270		1 volleyball court
2271		1 softball field w/backstop
2272		1 horseshoe court
2273		1 playground set with
2274		slide and swings
2275		1 merry-go-round
2276		2 vault toilets
2277		2 park benches
2278		1 water fountain
2279		

3.3.9.7 Tuttle Creek ORV Area and Spillway Cycle Area

The Tuttle Creek ORV Area is located on the west side of the lake, 2 miles southeast of Randolph, Kansas with access off Riley County Road 893 to Secrest Road, then 1 ½ miles east. The area is operated and maintained by the Corps. This 310-acre area is open to all motorized and non-motorized vehicles. The area includes miles of trails with steep climbs, sharp turns, and rugged terrain for use by the off-road enthusiast. Vault toilets are available adjacent to the entrance parking lot. The area is for day-use recreation only and no camping or overnight use is permitted. The area is closed from sunset to sunrise. No campfires, hunting, or firearms are allowed in the area.

The Spillway Cycle Area adjoins the spillway just below the east end of Tuttle Creek Dam, with access off of Dyer Road. The area is operated and maintained by the Corps. The area is open from 9 a.m. to 9 p.m. year-round. The Cycle Area comprises 90 acres of open and wooded terrain adjacent to the spillway. Several miles of trails have been developed, ranging from level stretches to challenging hill climbs. Vault toilets, picnic tables, and a loading ramp are available adjacent to the

entrance parking lot. The area is open to bicycles and to all 2-, 3-, and 4-wheeled motorized vehicles with a wheelbase under 66 inches. Dune buggies, four-wheel drive vehicles and other machines with a wheelbase greater than 66 inches utilize the Tuttle Creek ORV Area described above. The area is for day-use recreation only and no camping or overnight use is permitted. No campfires, hunting, or firearms are allowed in the area.

3.3.9.8 Radio Controlled Flying Field

The radio-controlled flying field is located on the west side of the spillway. This 4.4-acre area is leased from the Corps by the RC Flyers, a group that fly radio controlled airplanes. This group initially leased the area in 1990 and the current agreement extends through 2010. Improvements at the flying field include a small, 10 x 10' storage shed, a small set of bleachers and a fence around the area. The group mows the viewing area and runway.

3.3.9.9 Special Events

There are three special events that occur annually at Tuttle Creek Lake, Eagle Days, Tuttle Creek Lake Festival, and Country Stampede. Eagle Days usually occurs on the first Saturday of January. The event includes programs on bald eagles and offers opportunities to view bald eagles.

The Tuttle Creek Lake Festival is held in the early part of June each year. It includes a vintage car rally, races, demonstrations, concerts, an arts and crafts show, and fireworks in the evening.

The Country Stampede is held the third weekend of June in River Pond State Park. This is a large country music festival that typically attracts 100,000 people and is held over four days. The Country Stampede features headline country and western artists. It is a major event for the area attracting visitors from all over the country. KDWP estimates that this event alone generates several million dollars for the Manhattan community and over \$85,000 annually to KDWP.

In addition, there are many other smaller special events held at Tuttle Creek Lake each year. These would include events sponsored by KDWP, local organizations or area businesses.

3.3.9.10 Recreation Related Businesses

Three recreation related businesses are located at Tuttle Creek Lake or in the immediate area, Big Dawg Marina, Kansas River Outfitters, and Bottger's Marine.

As discussed in Section 3.3.9.3, Big Dawg Marina is located in Spillway State Park. The facilities and services at the marina include 40 covered slips, 5 uncovered slips, boat and motor rental and repair, boat, tackle, grocery, and fuel sales, and snack bar.

Kansas River Outfitters are located in the River Pond State Park. They provide canoe, paddleboat, and pontoon boat rentals, boat, fishing equipment, and grocery sales, firewood, campfire catering, and offer a guide service for float trips on various rivers.

Bottger's Marine is located approximately two miles south of Tuttle Creek Lake. They are in the retail boat sales business and sell pleasure boats, fishing boats, pontoon boats, and ski boats. Bottger's Marine also offers boating accessories, service, and boat storage.

3.3.10 Archaeological & Historic Resources

The Tuttle Creek Lake area was periodically occupied throughout the prehistoric period. Isolated Paleoindian points found at Tuttle Creek Lake indicate the region was visited or occupied 11,000-12,000 years ago. Early Archaic, Early Ceramic, and Middle Ceramic Periods artifacts have been found at various historic properties and potentially eligible sites. The Late Ceramic Period has not been confirmed within project boundaries.

Historically, the Kansa and Pawnee tribes were in the region; however, no sites of these cultures have been confirmed at the lake. Euro-American settlements and towns were located within project boundaries, but razed for lake construction.

The fee lands at Tuttle Creek Lake contain 133 archeological sites and seven former historic townsites. Twenty-eight archeological sites and three historic townsites are below the multipurpose pool elevation of 1,075 ft. m.s.l. North of the Highway 16 (Randolph) Bridge, the lake is filled with sediment. Because of the sediment, changes in the multipurpose pool elevation associated with any alternative would not affect sites north of the bridge including the Coffey Site, 14PO1, listed on the National Register of Historic Places. A description of potentially affected sites located on fee lands at Tuttle Creek Lake is included in Appendix E – Cultural Resource Sites at Tuttle Creek Lake.

The Corps in consultation with the State Historic Preservation Office identified 20 known archaeological sites and 11 Government Land Office (GLO) recorded historic sites listed on the state inventory that are located within the area that would be inundated should an uncontrolled release of the Tuttle Creek pool occur. The vast majority of these sites have not been evaluated for eligibility for inclusion on the National Register of Historic Places. Since much of this area has

not been surveyed, it would be highly probable that there are additional archaeological sites and standing historic structures in this area. None of these 31 sites within the potential inundation area are currently listed on the National Register of Historic Places.

3.3.11 Environmental Justice

The Executive Order on Environmental Justice (Executive Order 12898) focuses on social equity issues, particularly any potential disproportionate impacts on minority or low-income groups. No specific geographic areas of minority or low-income groups were identified within the affected area. Looking at the population of Riley and Pottawatomie Counties respectively, the population is 84.8% and 96.3% percent white, compared to 86.1 percent in the State of Kansas and 75.1 percent in the U.S. Blacks comprise only 6.9% and 0.7% of the population in these counties, compared to 5.7 percent in the State of Kansas and 12.3 percent in the nation. Hispanics account for 4.6% and 2.3% respectively of the Riley and Pottawatomie Counties population, which is less than the 7.0% share of Hispanics in the State of Kansas and much less than the 12.5% share of the total population accounted for by Hispanics nationally.

The median household income in Riley and Pottawatomie Counties respectively is \$33,744 and \$38,587, compared with the State of Kansas \$36,488 and the nation at \$37,005. The percent of the persons living below the poverty line in these counties is 14.1% and 8.4% compared with the State of Kansas at 10.9% and the nation at 13.3%.

Mapping used for the consideration of environmental justice impacts of the Tuttle Creek Dam Safety Assurance Program were prepared by the Environmental Protection Agency through a Geographical Information System using population and income data from the 1990 and 2000 Census, the Environmental Protection Agency Highway Planning Network, and the U.S. Geological Survey National Hydrography Dataset. Figures 12 through 16 show the percent of households below the \$12,500 annual income poverty level and the percent of the Black, Hispanic, Asian, and American Indian populations. The information shown on these Figures is summarized in the Environmental Justice Population Summary Table, shown below. For the purposes of this table, the areas considered were the upstream areas immediately adjacent to the lake and the downstream areas that would be directly impacted by flooding should the dam fail during an earthquake. Within the City of Manhattan, only those areas inundated as a result of dam failure, as shown on Plates 1 and 2 of the Evaluation Report are considered for inclusion in the table below.

In general, the unincorporated areas upstream of the dam have very low percentage minority populations while unincorporated areas downstream of the dam have slightly higher minority populations. The potentially flooded portions of the City of Manhattan include portions of the highest minority population percentages in the region. However, with the exception of the Black population, non-inundated

areas within Manhattan have equally high or higher Asian, Hispanic, and American Indian populations. The single census block in Manhattan with 12-24 percent of the population being Black is located within the potentially inundated area.

	Percent <\$12,500 Annual Income	Percent Black Population	Percent Asian Population	Percent Hispanic Population	Percent American Indian Population
Upstream Riley County	8-14	0-1	0-1	2-3	0-1
Upstream Pottawatomie County	0-7	0-1	0-1	2-3	0-1
Downstream Riley County	8-14	1-11	0-2	4-8	0-1
Downstream Pottawatomie County	0-7	0-3	2	2-4	0-1
Downstream Manhattan	0-73	2-24	0-11	4-8	0-3

Environmental Justice Population Summary Table

The distribution of households below the poverty level is equally distributed upstream and downstream of the dam with the Riley County side having a slightly higher percentage. Within the potentially inundated areas of Manhattan, the census blocks show a range of households from zero to 73 percent below the poverty line. The potentially inundated area of Manhattan includes census blocks with a higher percentage of households below the poverty line than any other potentially impacted area. However, other non-inundated areas of Manhattan have equally high percentages of households below the poverty level.

Based on the data presented above, none of the five alternatives considered for evaluation in this report disproportionately impact low income or minority groups in the project area. The impacts of each of the alternatives considered affect the population within the project area regardless of income or race.

4. Significant Environmental Effects of the Proposed Alternatives

4.1 Physical-Chemical Environment

4.1.1 Geology, Minerals and Soils

“No Action” Alternative

The “No Action” alternative would have no effects on geology, minerals and soil resources in the project area.

2464 In the event of a seismic related dam failure, erosion associated with the
2465 uncontrolled release of the pool would substantially damage the earthen dam
2466 embankment. Restoration of the dam would require a large amount of earthen
2467 material.

2468 2469 **Restricted Lake Operation**

2470
2471 Restricted Lake Operation alternative would result in the exposure of a large
2472 amount of the lakebed that is currently below multipurpose pool. In order to prevent
2473 soil erosion extensive areas would require planting to vegetation and in some areas
2474 new rock protection may be required and existing rock protection may need to be
2475 extended.

2476 2477 **Stabilize Foundation Soil with Drawdown (C.2 in FEvR)**

2478
2479 The jet grouting/deep soil mixing component of the Stabilize the Foundation
2480 Soil alternative (preferred) would require large quantities of cement. This cement
2481 would be transported to the site in bags or bulk by large semi truck/trailer.
2482 Considering the large amount of cement required for the project over the extended
2483 construction period, the Corps contacted an industry representative to determine
2484 what quantity could reasonably be supplied without creating logistical problems.
2485 The representative indicated that the material could come by truck from areas in
2486 Oklahoma and potentially Missouri and that 50,000 tons per year could be readily
2487 supplied. The industry representative also indicated that using greater than 75,000
2488 tons per year would probably exceed the existing capabilities of the suppliers. The
2489 projected quantities needed to construct this alternative should be within the
2490 capabilities of the industry to supply.

2491 2492 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

2493
2494 Same as Stabilize Foundation Soil with Drawdown.

2495 2496 **Enlarge Embankment**

2497
2498 The jet grouting/deep soil mixing component of the Enlarge Embankment
2499 alternative would require large quantities of cement but less than the amount
2500 required to construct the Stabilize Foundation Soil alternatives. This cement would
2501 be transported to the site in bags or bulk by large semi truck/trailer. Considering the
2502 large amount of cement required for the project over the extended construction
2503 period, the Corps contacted an industry representative to determine what quantity
2504 could reasonably be supplied without creating logistical problems. The
2505 representative indicated that the material could come by truck from areas in
2506 Oklahoma and potentially Missouri and that 50,000 tons per year could be readily
2507

2507 supplied. The industry representative also indicated that using greater than 75,000
2508 tons per year would probably exceed the existing capabilities of the suppliers. The
2509 projected quantities needed to construct this alternative should be within the
2510 capabilities of the industry to supply.

2511
2512 Construction of the berms would require the placement of large quantities of
2513 fill material on the upstream side and downstream side of the dam. Most of this
2514 material, used to initially construct the dredged material containment berms, would
2515 come from the existing rock on the dam. Material for the upstream side would be
2516 hydraulically dredged from nearby areas in Tuttle Creek Lake. Material from the
2517 downstream berm would be dredged from nearby areas in River Pond. If the
2518 project exceeds the capacity of these areas to provide the necessary quantity of fill
2519 material, other upland borrow sites on project land or commercial borrow sources in
2520 the project area could be used.

2521 2522 **4.1.2 Water Resources and Water Quality**

2523
2524 Water supply is discussed in Section 4.3.5 Utilities and Water Supply.

2525 2526 **“No Action” Alternative (A. in FEvR)**

2527
2528 There would be no ground or surface water impacts under the “No Action”
2529 Alternative.

2530
2531 The current TMDLs would remain in effect. NPDES permit limits would not
2532 be affected by this action.

2533
2534 Should a major seismic event result in failure of the dam and uncontrolled
2535 release of the Tuttle Creek pool, the capability of Tuttle Creek Lake to provide water
2536 quality releases would be lost until such time as the dam/lake could be restored. In
2537 addition, detention time would be eliminated. Loss of the pool would expose large
2538 areas of the lakebed to erosion that could further reduce water quality. The existing
2539 detention time provided by the lake would be eliminated. In addition, loss of the
2540 pool would likely cause reductions in the water levels and yields of dug overburden
2541 wells and shallow bedrock wells immediately adjacent to the lake. These impacts
2542 would be of primary concern in the upper end of the lake above Baldwin Creek.
2543 Deep wells used for drinking water supply and wells not immediately adjacent to the
2544 lake would not be significantly impacted by the lake level reduction.

2545 2546 **Restricted Lake Operation (B.4 in FEvR)**

2547 2548 **Groundwater:**

2549
2550 Implementation of the Restricted Lake Operation alternative would be likely
2551 to cause reductions in the water levels and yields of dug overburden wells and
2552 shallow bedrock wells immediately adjacent to the lake. These impacts would be of
2553

primary concern in the upper end of the lake above Baldwin Creek. Deep wells used for drinking water supply and wells not immediately adjacent to the lake would not be significantly impacted by the lake level reduction.

Groundwater levels below the dam would not be significantly impacted by a permanent lake level reduction since controlled seepage below the dam would still occur. Groundwater quality would not be impacted in any area under this alternative. The existing detention time provided by the lake would be reduced.

Surface water:

Atrazine and Alachlor concentrations would be expected to increase in an alternative that specifies a drawdown as these compounds are typically found in higher concentrations near the reservoir bed. Drinking water use would likely be impaired without organics removal capability at water supply facilities. Aquatic life use may be challenged by increased concentrations of these compounds in the water column. In addition, further impairment is likely to occur to other water quality criteria parameters.

The permanent lake drawdown to elevation 1,050 ft., m.s.l. will expose large areas of the lakebed to erosion during high inflow and rainfall events. Erosion of these exposed areas could result in increased turbidity and redeposition of sediment. Aerial seeding of the exposed area could be used to minimize these effects. Since Tuttle Creek Lake will continue to be operated for flood control, greater fluctuations in lake level would be expected than under the "No Action" alternative. Much of this exposed lakebed area would never support permanent vegetation. Yearly aerial seeding could minimize these effects. In addition, some permanent stabilization may be required adjacent to important infrastructure. Detention time would be reduced under this alternative.

The Corps utilized inflow information from the years of 1983 through 1993 and applied operation with a multi-purpose pool elevation of 1,050 ft., m.s.l. to this data to get an idea of how operation at this lower multi-purpose pool elevation would have affected downstream water quality releases. The Corps also look at how water quality releases would be affected during a severe drought comparable to the one experienced in the 1950s.

Considering the historic record, in most years Tuttle Creek Lake would be capable of meeting existing water quality flow requirements using a 1,050 ft., m.s.l. multi-purpose pool elevation. This operation is shown in Figure 8. However, even mild drought conditions could result in serious adverse drawdowns at Tuttle Creek Lake. Looking at the winter of 1991-1992, starting with a elevation 1,050 ft., m.s.l. multi-purpose pool and coupling existing water quality flow with water supply requirements could result in substantial drawdown of the Tuttle Creek pool. Basically this would drain Tuttle Creek Lake to fulfill these requirements. There would be an expected 30-foot drop of the pool to elevation 1,020 ft., m.s.l., but only 5 of this 30-foot drawdown would be attributable to releases for water quality.

Looking at a much more severe drought, as was experienced during the 1950s, the Corps determined that under the existing elevation 1,075 ft., m.s.l. multi-purpose pool the lake would only be partially emptied. Under the proposed multi-purpose pool elevation 1,050 ft., m.s.l. , the pool would be completely emptied

Permanent drawdown could affect several private interests that have water rights associated with Tuttle Creek Lake.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

Groundwater:

Implementation of the Stabilize Foundation Soil with Drawdown alternative would be likely to cause temporary reductions in the water levels and yields of dug overburden wells and shallow bedrock wells immediately adjacent to the lake during the temporary reduction of the lake level during construction. These impacts would be of primary concern in the upper end of the lake above Baldwin Creek. Deep wells used for drinking water supply and wells not immediately adjacent to the lake would not be significantly impacted by the lake level reduction.

Groundwater levels below the dam would not be significantly impacted by a temporary lake level reduction during construction. However, this alternative includes the installation of a permanent groundwater cutoff wall beneath the dam. This wall is intended to reduce water pressures beneath the dam. The relief wells at the downstream toe of the dam act as pressure relief valves. Reducing the pressures beneath the dam will reduce or eliminate the volume of water discharged from the relief wells. During normal rainfall periods, water levels downstream of the relief wells are primarily dependent upon drainage from the hills to the east and water levels in the river and river pond. During extreme drought conditions, if releases from the lake cannot be made, it is possible that the water level in the River Pond may drop below levels it has historically seen since groundwater flow beneath the dam will not be available to provide a "base flow" in the valley. The level of River Pond will be solely dependent upon river levels and discharge from the outlet works. Groundwater downstream of River Pond would not be impacted. The existing detention time provided by the lake would be reduced during the 7-10 year construction period.

Upstream groundwater quality would not be impacted by this alternative.

This alternative involves the injection of cement mixtures into the foundation sands. In the long term, the presence of solidified cement would not impact downstream groundwater quality. However, during construction, it is possible that the pH of groundwater discharged from the relief wells in the immediate vicinity of the work could temporarily increase. It is also possible that the turbidity of the relief well discharge could temporarily increase when working immediately adjacent to the wells. These impacts would be temporary during construction and would be limited to the individual wells in the immediate area of treatment. Relief well discharges flow through ditches and eventually discharge to the River Pond. The overall

impacts to River Pond of these relatively small flows would be expected to be minimal. Changes to the groundwater pH would be negligible, if present at all, more than a few hundred feet downstream of the dam. Downstream of River Pond, groundwater pH changes would not be expected.

Considering probable reductions in the availability of extractable groundwater and the potential intermittent pH impacts, the water supply well for River Pond State Park would not be a reliable source of quality drinking water. Therefore, alternate water supply would be required. The existing well will be abandoned and the State Park will be connected to the rural water supply system that exists to the southeast along Dyer Road. Payment for water usage will be the responsibility of the State Park. Groundwater quality changes in the form of pH variations are only expected to occur during construction.

Surface water:

Atrazine and Alachlor concentrations would be expected to increase in an alternative that specifies a drawdown as these compounds are typically found in higher concentrations near the reservoir bed. Drinking water use would likely be impaired without organics removal capability at water supply facilities. Aquatic life use may be challenged by increased concentrations of these compounds in the water column. In addition, further impairment is likely to occur to other water quality criteria parameters.

During construction of the work platform on the upstream face of the dam there could be increased runoff, turbidity and sediment in Tuttle Creek Lake related to the construction activity. These effects would occur primarily in the area immediately adjacent to the upstream face of the dam but may also affect the Big Blue River immediately downstream. Lowering the pool to elevation 1,050 ft., m.s.l. will allow most of the platform construction work to occur in the dry to avoid and/or minimize most of these effects. In addition, constructing the work platform out of the clean rock fill that is currently on the face of the dam will further minimize these effects. After initial construction of the work platform is complete, spoil material from the jet grouting/deep soil mixing activity will be stabilized in place as part of the platform. All spoil material and associated runoff will be prevented from entering the lake by either permanent or temporary covering with rock riprap, and by using detention basins and other appropriate runoff control measures adjacent to the work area.

In addition, the lake drawdown will expose large areas of the lakebed to erosion during high inflow and rainfall events. Erosion of these exposed areas could result in increased turbidity and redeposition of sediment. Ariel seeding of the exposed area could be used to minimize these effects.

Temporary drawdown could affect several private interests that have water rights associated with Tuttle Creek Lake.

Monitoring and containment and treatment as necessary will be performed for runoff from treatment areas that may contain excess suspended solids or have a high pH. This work will be performed in accordance with a National Pollution Discharge Elimination System permit to be obtained through the Kansas Department of Health and the Environment. The specific criteria and locations for monitoring will be documented in the permit that will be obtained before the initiation of construction.

With the installation of a groundwater seepage cutoff wall beneath the dam, the quantity of water discharged from the downstream relief wells should decrease significantly. Decreased relief well flow may also result in some reduction in the size of the downstream wetland area toward the west end of the dam. If this reduction occurs, expansion and modification of the area to restore its original size will be performed.

During placement of rockfill or other materials that may increase turbidity in the lake, turbidity curtains or other measures to control the spread of fine sediments in the water will be employed. These measures will only be used during active construction in the lake and will not remain in place for the duration of the construction.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

Groundwater:

There would be no upstream groundwater impacts for the Stabilize Foundation Soil without Drawdown alternative.

Downstream groundwater level, quantity, and quality impacts would be the same as for the Stabilize the Foundation Soil with Drawdown alternative.

Surface water:

Current TMDLs would remain in effect. NPDES permit limits would not be affected by this action.

This alternative would involve no drawdown of the lake pool and the upstream work platform would be constructed in the "wet". During construction of the work platform on the upstream face of the dam there could be increased runoff, turbidity and sediment in Tuttle Creek Lake. This would be greater than that expected under the Stabilize Foundation Soil with Drawdown alternative as the fill placement would often be in direct contact with the water. To minimize these effects, the platform construction work would be completed during expected normal low lake levels. In addition, constructing the work platform out of the clean rock fill that is currently on the face of the dam will further minimize these effects. Floating silt curtains will be used during construction of the work platform adjacent to the work area to minimize the affects of increased turbidity. After initial construction of the work platform is complete the water quality effects of this alternative would be

the same as Stabilize the Foundation Soil with Drawdown. Spoil material from the jet grouting/deep soil mixing activity will be stabilized in place as part of the platform. All spoil material and associated runoff will be prevented from entering the lake by either permanent or temporary covering with rock riprap, and by using detention basins and other appropriate runoff control measures adjacent to the work area. Compared with the Stabilize Foundation Soil with drawdown alternative there will be a minor increase in the probability that lake levels could raise enough to inundate the work platform. Stabilizing the treated area and spoil material in the work platform with rock riprap, as the work progresses will minimize these impacts.

There would be no lake drawdown and therefore no increased turbidity impacts associated with the exposure of large areas of the lakebed to erosion. Existing detention time would be maintained. Downstream water quality releases would not be affected.

Private interests that have water rights associated with Tuttle Creek Lake would not be affected under this alternative.

Appendix J of this document contains the Kansas Department of Health and Environment's Section 401 Water Quality Certification, dated August 29, 2002, for the proposed work described under the preferred alternative.

Enlarge Embankment (C.3 in FEvR)

Groundwater:

Implementation of the Enlarge Embankment alternative would be likely to cause temporary reductions in the water levels and yields of dug overburden wells and shallow bedrock wells immediately adjacent to the lake during the temporary reduction of the lake level during construction. These impacts would be of primary concern in the upper end of the lake above Baldwin Creek. Deep wells used for drinking water supply and wells not immediately adjacent to the lake would not be significantly impacted by the lake level reduction.

Groundwater levels below the dam would not be significantly impacted by a temporary lake level reduction during construction since controlled seepage below the dam would still occur. This alternative does not include a cutoff wall below the dam.

Upstream groundwater quality would not be impacted by this alternative.

This alternative involves the injection of cement mixtures into the foundation sands. In the long term, the presence of solidified cement would not impact downstream groundwater quality. However, during construction, it is possible that the pH of groundwater discharged from the relief wells in the immediate vicinity of the work could temporarily increase. It is also possible that the turbidity of the relief well discharge could temporarily increase when working immediately adjacent to the wells. These impacts would be temporary during construction and would be limited

to the individual wells in the immediate area of treatment. Relief well discharges flow through ditches and eventually discharge to the River Pond. The overall impacts to River Pond of these relatively small flows would be expected to be minimal. Changes to the groundwater pH would be negligible if present at all more than a few hundred feet downstream of the dam. Downstream of River Pond, groundwater pH changes would not be expected.

Considering probable reductions in the availability of extractable groundwater and the potential intermittent pH impacts, the water supply well for River Pond State Park would not be a reliable source of quality drinking water. Therefore, alternate water supply would be required.

Surface water:

Atrazine and Alachlor concentrations would be expected to increase in an alternative that specifies a drawdown as these compounds are typically found in higher concentrations near the reservoir bed. Drinking water use would likely be impaired without organics removal capability at water supply facilities. Aquatic life use may be challenged by increased concentrations of these compounds in the water column. In addition, further impairment is likely to occur to other water quality criteria parameters.

Effects of this alternative would be similar to the Stabilize the Foundation Soil with Drawdown. Additional effects would be associated with the construction of berms that are substantially larger than the work platforms used under the Stabilize Foundation Soil alternatives. In addition, hydraulic dredging of material from the lake to construct the berms would result in increased turbidity and redeposition of sediment. The types of measures to minimize these effects would be the same as under Stabilize Foundation Soil with Drawdown but because of the extent of the work and use of hydraulic fill a greater effort would be required to minimize the potential effects. Instead of stabilizing spoil material used to construct the work platform under the Stabilize Foundation Soils alternatives, the same measures would be applied to the hydraulically dredged material used to construct the large berms.

4.1.3 Air Quality

“No Action” Alternative (A. in FEvR)

Under the “No Action” Alternative there would be no construction or changes in the existing operation of Tuttle Creek Lake. Therefore no changes in the existing air quality would be expected.

Under this alternative there is the remote possibility of a seismic related dam failure and uncontrolled release of the Tuttle Creek pool. Should that occur there would probably be air quality impacts resulting from extensive construction during restoration and repair of the dam and cleanup of flood damage in downstream areas. These impacts would be similar those described under Stabilize Foundation

Soil and Enlarge Embankment alternatives. In addition, large areas of the lakebed would be exposed. Depending on timing and weather conditions, these areas could dry out and then be exposed to high winds resulting in windblown dust.

Restricted Lake Operation (B.4 in FEvR)

Under this alternative the proposed permanent drawdown would result in large areas of the lakebed being exposed during normal operations. Depending on timing and weather conditions, these areas could dry out and then be exposed to high winds resulting in windblown dust. Some areas could be stabilized with vegetation, but because of the continuing operation for flood control, large areas would not be able to support vegetation and would be subject to wind erosion. Some minor construction work could be needed to extend existing or construct new bank stabilization, and to modify existing recreation facilities. These temporary construction equipment related air quality impacts under this alternative would be much less than those expected under the 3 major construction alternatives.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The Stabilize Foundation Soil with Drawdown alternative will require extensive construction activity and a lake drawdown during a 7-10 year construction period. Numerous types of heavy construction equipment, i.e. bulldozers, drill rigs, trucks, loaders, graders, etc., will be used to complete construction of the project. In addition, a batch plant will be constructed onsite to mix and supply cement. The proposed batch plant would be expected to operate 24 hours per day. Construction activity on the dam will probably be at minimum 12- 20 hours per day. Most of this construction equipment is powered by internal combustion engines, which adversely affect air quality. In addition, the construction activity has the potential to expose areas to wind erosion, and the operation of construction equipment on the site can result adverse impacts to air quality related to the large amounts of windblown dust.

Under this alternative the proposed 7-10 year construction period lake drawdown would result in large areas of the lakebed being exposed. Depending on timing and weather conditions, these areas could dry out and then be exposed to high winds resulting in windblown dust. Some areas could be stabilized with vegetation, but because of the continuing operation for flood control, large areas would not be able to support vegetation and would be subject to wind erosion. Some minor construction work could be needed to extend existing or construct new bank stabilization, and to modify existing recreation facilities.

In order to avoid and/or mitigate air impacts, standard Corps of Engineers dust control measures will be implemented at the construction site. Disturbed areas on the construction site will be seeded, watered or covered as appropriate to minimize exposure. Haul roads and dry material that is being handled that creates dust will be regularly watered to avoid excessive dust generation. In addition, exposed areas of the shoreline would be seeded with vegetation to minimize wind erosion and associated effects on air quality from windblown dust.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

Air quality impacts associated with the Stabilize Foundation Soil without Drawdown alternative would be the same as those listed for the Stabilize the foundation Soil with Drawdown alternative with the exception that there would be no drawdown related windblown dust resulting from exposure of the lake bottom.

Enlarge Embankment (C.3 in FEvR)

Air quality impacts associated with the Enlarge Embankment alternative would be very similar to those listed for the Stabilize the foundation Soil with Drawdown alternative.

4.1.4 Noise

“No Action” Alternative

The “No Action” Alternative would have no affect on noise in the project area.

In the unlikely event of a seismic related dam failure, heavy construction equipment needed to restore the dam would produce noise impacts similar to those described for the Stabilize Foundation Soil and Enlarge Embankment alternatives. In addition, cleanup and restoration of infrastructure affected by downstream flooding would produce additional noise impacts, especially within the City of Manhattan.

Restricted Lake Operation

The Restricted Lake Operation Alternative would potentially have long-term minimal adverse effect on noise in the project area. Assuming no reduction in boating activity, the proposed reduction in the surface area of the multi-purpose pool would tend to concentrate boaters in a smaller area. Visitors using the lake and adjacent recreation areas would experience increased noise impacts. These effects would be most noticeable on high use weekends in the summer. These effects would be considered minor and probably well within the acceptable level of the recreation users.

In the unlikely event of a seismic related dam failure, heavy construction equipment needed to restore the dam would produce noise impacts similar to those described for the Stabilize Foundation Soil and Enlarge Embankment alternatives. In addition, cleanup and restoration of infrastructure affected by downstream flooding, although less than that required under the “No Action” alternative, would produce additional noise impacts.

Stabilize Foundation Soil with Drawdown

The Stabilize Foundation Soil with Drawdown alternative would involve the operation of several large gasoline powered jet grouting/deep soil mixing rigs, bulldozers, graders, and large cement trucks on a daily basis over the estimate 7-10 year construction period. This type of equipment would be operated up to 18 hours per day. In addition, a batch plant would be constructed and operated on-site to provide cement needed for the construction activity. The batch plant would be expected to be in operation 24 hours per day. The construction activity noise would be expected to adversely affect recreational users and nearby residents of Tuttle Creek Lake. Nearby residents, recreational users in areas just upstream of the dam and in River Pond State Park and the outlet area would be most affected. While some day use visitors, i.e. picnickers, fishermen, power boaters, may be tolerant of this increased noise, others user, especially campers at River Pond State Park, would be expected to use other areas.

As noted under Restricted Lake Operation, assuming no reduction in boating activity, the proposed reduction in the surface area of the multi-purpose pool during the 7-10 year construction period would tend to concentrate boaters in a smaller area. Visitors using the lake and adjacent recreation areas would experience increased noise impacts. These effects would be most noticeable on high use weekends in the summer. These effects would be considered minor and probably well within the acceptable level of the recreation users.

Large trucks would be bringing equipment and supplies, in particular the large amount of cement needed to construct the project, through the City of Manhattan to the proposed construction site at Tuttle Creek Dam. The proposed route of travel would be from I-70, north on U.S. 77, through Manhattan, and then east on State Route 13 to the construction site. Currently we estimate that this would add approximately 20 large commercial vehicles per day to the existing traffic on these roadways. Currently these roadways are open to commercial truck traffic. Considering the existing traffic and associated noise levels on these roadways, we do not believe that the minor increases in noise associated with trucks moving construction equipment and material through the City of Manhattan to the construction site would adversely affect any nearby residences or businesses.

To mitigate the effects of construction noise on nearby residents and project visitors, construction contractors will be required to maintain effective muffler systems on all equipment. In addition, efforts will be made to confine the highest noise producing activities to daylight hours when possible.

2971 **Stabilize Foundation Soil without Drawdown (preferred)**

2972
2973 The Stabilize Foundation Soil without Drawdown alternative would result in
2974 the same adverse noise effects as those described under Stabilize Foundation Soil
2975 with Drawdown alternative with the exception that the existing boating activity and
2976 associated noise would not be restricted to a smaller lake area as a result of a
2977 drawdown.

2978
2979 **Enlarge Embankment**

2980
2981 The Enlarge Embankment alternative would involve the operation of several
2982 large gasoline powered jet grouting/deep soil mixing rigs, hydraulic dredges,
2983 bulldozers, graders, backhoes and large cement trucks on a daily basis over the
2984 estimate 7-10 year construction period. This type of equipment would be operated
2985 up to 18 hours per day. In addition, a batch plant would be constructed and
2986 operated on-site to provide cement needed for the construction activity. The batch
2987 plant would be expected to be in operation 24 hours per day. The construction
2988 activity noise would be expected to adversely affect recreational users and nearby
2989 residents of Tuttle Creek Lake. Nearby residents, recreational users in areas just
2990 upstream of the dam and in River Pond State Park and the outlet area would be
2991 most affected. While some day use visitors, i.e. picnickers, fishermen, power
2992 boaters, may be tolerant of this increased noise, others user, especially campers at
2993 River Pond State Park, would be expected to use other areas.

2994
2995 As noted under Restricted Lake Operation, assuming no reduction in boating
2996 activity, the proposed reduction in the surface area of the multi-purpose pool during
2997 the 7-10 year construction period would tend to concentrate boaters in a smaller
2998 area. Visitors using the lake and adjacent recreation areas would experience
2999 increased noise impacts. These effects would be most noticeable on high use
3000 weekends in the summer. These effects would be very minor and probably well
3001 within the acceptable level of the recreation users.

3002
3003 Large trucks would be bringing equipment and supplies, in particular the
3004 large amount of cement needed to construct the project, through the City of
3005 Manhattan to the proposed construction site at Tuttle Creek Dam. The proposed
3006 route of travel would be from I-70, north on U.S. 77, through Manhattan, and then
3007 east on State Route 13 to the construction site. Currently we estimate that this
3008 would add approximately 20 large commercial vehicles per day to the existing traffic
3009 on these roadways. Currently these roadways are open to commercial truck traffic.
3010 Considering the existing traffic and associated noise levels on these roadways, we
3011 do not believe that the minor increases in noise associated with trucks moving
3012 construction equipment and material through the City of Manhattan to the
3013 construction site would adversely affect any nearby residences or businesses.

3014
3015 To mitigate the effects of construction noise on nearby residents and project
3016 visitors, construction contractors will be required to maintain effective muffler
3017 systems on all equipment. In addition, efforts will be made to confine the highest
3018 noise producing activities to daylight hours when possible.

4.2 Biological Environment

As described under 3.2 Biological Environment (Affected Environment) there are many important natural resources associated with Tuttle Creek Lake and areas downstream on the Kansas River floodplain. These include natural vegetation, and fish and wildlife resources including threatened and endangered species. Many of the recreational opportunities and the overall quality of human life in the study area are either dependent or greatly enhanced by these natural resources. The Kansas Department of Wildlife and Parks operates wildlife management lands at Tuttle Creek Lake under license agreement with the Corps. In addition, the Corps manages extensive areas at Tuttle Creek Lake. The Corps in order to gain a better understanding of how potential alternatives being considered in the Dam Safety Assurance Program could potentially affect these natural resources at Tuttle Creek Lake and areas located downstream on the Kansas River floodplain solicited input from the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service.

Comments of the U.S. Fish and Wildlife Service can be found in their Draft Coordination Act Report (CAR) that is included in Appendix B of this FEIS. The Corps responses to recommendations provided by the USFWS in the CAR are included in Section 8.0 of the FEvR. Scoping comments of the Kansas Department of Wildlife and Parks are provided in their letter dated March 4, 2002 and included as Appendix C of this FEIS.

4.2.1 Terrestrial Ecosystem

4.2.1.1 Vegetation

“No Action” Alternative

The “No Action” Alternative would result in no effects to vegetation in the study area. There would be no construction activity and no operational changes at Tuttle Creek Lake.

Under this alternative there is the remote possibility of a seismic related dam failure and uncontrolled release of the Tuttle Creek pool. Should that occur there would be substantial short-term adverse effects to vegetation located in the inundated area and adjacent to Tuttle Creek Lake. Because of the short duration of inundation expected, 3 days, most trees would survive. Downstream, some trees could be destroyed by the force of the high flows, drift, or scouring associated with the uncontrolled release. If occurring during the growing season or before harvest, agricultural crops in the inundated area could be destroyed. Considering the extent of the area, this would represent a major economic loss. Vegetation adjacent to the lake may experience some minor temporary impacts until such time as the dam is

restored and the lake is returned to the multipurpose pool elevation. The most severe effects would be expected to occur in wetland vegetation adjacent to the lake. Overall, although occurring over an extensive area, most impacts to vegetation would be temporary.

Restricted Lake Operation (B.4 in FEvR)

The permanent lowering of the pool to a new multi-purpose pool elevation of 1,050 ft., m.s.l. would affect vegetation that is adjacent to the lake. Much of the existing vegetation located in the upper part of the lake is in a constant state of flux, dependant on amounts and timing of inflow. This change from the existing hydrologic regime would mean that the existing vegetation around the lake would experience drier conditions and greater fluctuation. This could affect the developed marsh areas adjacent to the upper end of the Lake, i.e. Fancy Creek Marsh, Swede Creek Marsh, Timber Creek Marsh. The lower lake pool would expose an extensive amount of additional area that could become vegetated. Since the lake would still be utilized for flood control some of this area would be inundated enough that at best it would support some seasonal vegetation, some of the newly exposed areas would be expected to support more permanent vegetation. Areas that currently support wetland vegetation in the upper part of the lake may be inundated less often. This could result in a shift to plants that are tolerant of drier conditions and one would expect a shift in the location of wetland vegetation to a lower elevation consistent with the lowered pool. While herbaceous plants would be expected to adjust fairly quickly, some species of woody vegetation could take several years to respond to the changed condition.

There would be no clearing of vegetation to accomplish construction activities under this alternative.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The affects to vegetation under the Stabilize the Foundation Soil with Drawdown would be very similar to those associated with the Restricted Lake Operation Alternative. These effects would be restricted to the 7-10 year construction period at which time the multi-purpose pool would be returned to elevation 1,075 ft., m.s.l. Vegetation that developed on the newly exposed areas would become inundated and one would expect to see a shift in vegetation back to the location and species composition that currently exists.

There would be minor disturbance of vegetation as a direct result of the construction activity. The construction area is in a heavily develop area and would mainly involved disturbance of developed lawn areas within River Pond State Park. Only very minimal, if any, clearing of trees would be expected.

3110 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

3111
3112 There would be no drawdown related effects to vegetation under the
3113 Stabilize Foundation Soil without Drawdown Alternative.

3114
3115 Construction related impacts to vegetation would be the same as Stabilize
3116 Foundation Soil with Drawdown alternative.

3117
3118 **Enlarge Embankment (C.3 in FEvR)**

3119
3120 Very similar to the effects Described for Stabilize Foundation Soil with
3121 Drawdown. The main difference being that an additional area of developed lawn in
3122 River Pond State Park would be permanently covered by the large downstream
3123 berm.

3124
3125 **4.2.1.2 Wildlife**

3126
3127 **“No Action” Alternative (A. in FEvR)**

3128
3129 The “No Action” alternative would involve no construction or change in
3130 project operations. Therefore it would have no affect on wildlife in the project area

3131
3132 The “No Action” Alternative does not remove the remote possibility of a
3133 seismic related uncontrolled release of the Tuttle Creek pool. If this should occur,
3134 wildlife resources associated with Tuttle Creek Lake would be temporarily affected
3135 until such time as the dam was restored and the lake returned to the multipurpose
3136 pool elevation. Wildlife resources located downstream on the inundated area of the
3137 Big Blue and Kansas River floodplains would also be at least temporarily affected
3138 by the uncontrolled release of the pool.

3139
3140 **Restricted Lake Operation (B.4 in FEvR)**

3141
3142 The Restricted Lake Operation alternative would have the greatest affect on
3143 wildlife of the alternatives being considered. The permanent lowering of the pool to
3144 elevation 1,050 ft., m.s.l. from the existing multipurpose pool elevation of 1,075 ft.,
3145 m.s.l. would result in substantial changes in the habitat surrounding Tuttle Creek
3146 Lake. The Restricted Lake Operation alternatives avoids the minimal effects to
3147 wildlife associated with the construction component of the Stabilize the Foundation
3148 Soil with Drawdown, Stabilize Foundation Soil without Drawdown and Enlarge
3149 Embankment Alternatives.

3150
3151 Drawdown of the lake will change the existing wildlife habitat surrounding
3152 Tuttle Creek Lake. This change in habitat will be beneficial to some species and
3153 detrimental to others. Mud flats that develop during the initial drawdown could be
3154 beneficial to shorebirds using the area. The physical separation between the lake
3155 and existing riparian vegetation could make wildlife foraging along the lakeshore,
3156 watering at the lake or moving between the lake and feeding areas on land more
3157 susceptible to predation. USFWS in the CAR notes that as the lake is drawn down,

much of the area will be repopulated with thick stands of cottonwood-willows and that after several years of growth, this habitat will be very beneficial to deer, and possibly turkey. In addition, beaver, muskrat, mink, and red-winged blackbird would exploit the newly established cover.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The actual construction activity component of the Stabilize the Foundation Soil with Drawdown has the same minimal effects on wildlife as the Stabilize the Foundation Soil without Drawdown and Enlarge Embankment alternatives. In addition, the effects of the 7-10 year lake drawdown, while the same as the Enlarge Embankment alternative, would be of shorter duration than the permanent change in operation under Restricted Lake Operation alternative.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown would have the least affect on wildlife of the construction alternatives being considered. Only the “No Action” alternative would have less affect. Construction activity would be restricted to the embankment of the dam and nearby staging areas. These areas were heavily disturbed during original construction, are sparsely vegetated, and have minimal habitat value for wildlife. Completing the upstream construction berm without drawing the pool down would avoid the adverse effects to wildlife associated with the Restricted Lake Operation, Stabilize Foundation Soil with Drawdown and Enlarge Embankment alternatives.

Enlarge Embankment (C.3 in FEvR)

The Enlarge Embankment alternative would have very similar effects to wildlife as the Stabilize Foundation Soil with Drawdown alternative.

4.2.2 Aquatic Ecosystem (including fisheries and wetlands)

“No Action” Alternative (A. in FEvR)

The “No Action” Alternative would involve no construction activity and no change in project operations. Therefore, no effects to the aquatic ecosystem, including existing fisheries and wetland resources, would be expected.

The “No Action” Alternative does not remove the remote possibility of a seismic related uncontrolled release of the Tuttle Creek pool. If this should occur, wetlands associated with Tuttle Creek Lake would be temporarily affected until such time as the dam was restored and the lake returned to the multipurpose pool elevation. Wetland resources located downstream adjacent to the Kansas River would also be at least temporarily affected by the uncontrolled release of the pool. Some wetland areas could experience sediment deposition, which could reduce their extent or change their functions and values. Scouring flows associated with the uncontrolled release could create new or enlarge existing wetland areas on the

floodplain. Although affecting an extensive area, the impacts to wetlands would be temporary. Fish and wildlife resources associated with these wetland areas would be adversely affected temporarily by displacement and lack of food and cover.

Restricted Lake Operation (B.4 in FEvR)

Establishing a new multipurpose pool elevation of 1,050 ft., m.s.l., from the current 1,075 ft., m.s.l. would substantially reduce the amount of habitat available for fish at Tuttle Creek Lake. The current surface area of the lake at multipurpose pool elevation of 1,075 ft., m.s.l., totals approximately 12,500 surface acres with 104 miles of shoreline. Under the Restricted Lake Operation alternative the lake would be reduced to approximately 7,211 surface acres at the new multipurpose pool elevation of 1,050 ft., m.s.l., with a total of approximately 83.5 miles of shoreline. Initially, as the lake level was reduced, existing fish populations would be more concentrated in the smaller lake. This would make them more susceptible to predation, including human fishing pressure. Eventually, this reduction in available habitat would result in a permanently lower overall number of fish in the lake that would correspond to the carrying capacity of the available habitat. In addition, some fish would be passed through the outlet structure during the initial drawdown.

Under this alternative Tuttle Creek Lake would continue to be operated for flood control resulting in even greater fluctuations in the pool than is currently experienced under the "No Action" alternative. The extent of this fluctuation can be seen in Figure 7 which uses the historical inflows from a recent 10 year period and operation with a 1,050 ft., m.s.l. multi-purpose pool elevation. These greater fluctuations in the pool would adversely affect the fish population in Tuttle Creek Lake. Both KDWP and USFWS noted that a permanent or temporary drawdown of Tuttle Creek Lake would result in serious adverse impacts to the existing fisheries. The same factors adversely affecting the fisheries would also have an overall adverse effect on related aspects of the aquatic ecosystem. Wetland areas at the upper end of Tuttle Creek Lake would be affected by the change in hydrology. KDWP and USFWS both identified potential adverse effects to the constructed wetlands adjacent to the upper end of the lake

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The Stabilize the Foundation Soil with Drawdown alternative would have the same effects on the aquatic ecosystem as the Restricted Lake Operation alternative. Although not a permanent change in operation the 7-10 year construction drawdown would result in serious adverse effects on the aquatic ecosystem. Since these would be a temporary construction related effects, at the completion of construction mitigative measures could be implemented to restore the aquatic ecosystem to its pre-construction level. This would include developing a fisheries plan for management during construction and restocking during and after construction. In addition, the lake level management plan would be revised to maximize the benefits to the aquatic ecosystem when refilling the lake after construction.

Construction of the work platform across the upstream face of the dam would permanently eliminate some aquatic habitat but less than the large berms required by the Enlarge Embankment alternative. Construction of the work platform across the upstream face of the dam would be in the dry and impacts associated with constructing this platform in the wet, as described for the Stabilize Foundation Soil with Drawdown, would be avoided.

With the installation of a groundwater seepage cutoff wall beneath the dam, the quantity of water discharged from the downstream relief wells should decrease significantly. Decreased relief well flow may also result in some reduction in the size of the downstream wetland area toward the west end of the dam. If this reduction occurs, expansion and modification of the area to restore its original size or other suitable mitigation will be performed.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown would have the same construction related effects on the aquatic ecosystem as the Stabilize the Foundation Soil with Drawdown alternative. In addition, construction of the work platform across the upstream face of the dam would occur in the wet. This could affect water quality in the immediate project area and placement of fill would kill or displace aquatic organisms in the immediate work area. These effects would be restricted to the initial construction of the work platform. Construction of the work platform across the upstream face of the dam would permanently eliminate some aquatic habitat but less than the large berms required by the Enlarge Embankment alternative.

This alternative would avoid impacts to the aquatic ecosystem associated with a 7-10 year construction drawdown of the lake.

To minimize these effects appropriate erosion controls will be implemented during construction and will include floating silt curtains adjacent to the immediate work area.

Enlarge Embankment (C.3 in FEvR)

Effects of the Enlarge Embankment alternative would be the same as those associated with Stabilize the Foundation Soil with Drawdown. In addition, construction of the large berm across the upstream face of the dam would permanently eliminate aquatic habitat.

4.2.3 Threatened and Endangered Species

4.2.3.1 Bald Eagle

“No Action” Alternative

The “No Action” alternative would involve no construction activity and no change in the current operation of Tuttle Creek Lake. The “No Action” Alternative would have no effect on the Federally listed threatened bald eagle or its habitat. The “No Action” alternative would not preclude any of the Conservation Recommendations provided by the USFWS in their Biological Opinion.

Under this alternative, there is a very remote possibility that Tuttle Creek dam could experience a seismic related failure. The uncontrolled release of the Tuttle Creek pool would result in the temporary degradation of bald eagle habitat at Tuttle Creek Lake and along the Big Blue and Kansas Rivers downstream of Tuttle Creek Dam.

Restricted Lake Operation (B.4 in FEvR)

There would be no major construction activity on the dam under this alternative. This alternative would involve a permanent change from the current operation of Tuttle Creek Lake. Permanently lowering the lake from the existing multi-purpose pool elevation of 1,075 ft., m.s.l. to the elevation 1,050 ft., m.s.l. could adversely affect the Federally listed threatened bald eagle in the project area. Lowering of the pool could reduce wetland/aquatic habitat and therefore the overall number of migrating waterfowl available, which are preyed on by bald eagles. Greater fluctuation in lake level and overall reduction in the size of the pool would reduce number of fish available to bald eagles as prey. In addition, large perch trees and suitable nest trees would be physically located further from the main lake. This alternative may affect bald eagle habitat adjacent to Tuttle Creek Lake. Implementation of this alternative would require additional consultation with USFWS.

Under this alternative, there is a very remote possibility that Tuttle Creek dam could experience a seismic related failure. The uncontrolled release of the Tuttle Creek pool would result in the temporary degradation of bald eagle habitat at Tuttle Creek Lake and along the Big Blue and Kansas Rivers downstream of Tuttle Creek Dam.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

This alternative would involve major construction activity on the dam and temporary drawdown of the lake. Effects of the drawdown would be the same as those described under the Restricted Lake Operation alternative but would be limited to a 7-10 year construction period. While temporary lowering the lake from the existing multi-purpose pool elevation of 1,075 ft., m.s.l. to the elevation 1,050 ft., m.s.l. could adversely affect the Federally listed threatened bald eagle in the project

area, the actual construction activity on the dam would have no effect on the bald eagle or its habitat. Upon completion of the construction activity, current multipurpose pool elevation and lake level management plan would be reinstated. Implementation of this alternative would require additional consultation with USFWS.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

There would be no change in the current operation of Tuttle Creek Lake under this alternative. Bald eagles and their habitat would not be affected by the construction activity used to stabilize the foundation soil of the dam. As such, the Stabilize Foundation Soil without Drawdown alternative would have no effect on the bald eagle or its habitat. The Stabilize Foundation Soil without Drawdown would not preclude the implementation of Conservation Recommendations made by USFWS in their Biological Opinion. The Corps, KDWP and USFWS will continue coordinate on the design, construction and operation of the replacement camping facilities proposed for the area south of River Pond to ensure that this aspect of the project would have no effect on the bald eagle or its habitat. Winter closure of camping facilities to be constructed downstream of the River Pond to offset impacts of construction would prevent any potential conflict between bald eagles and the use of the area. In addition, removal of suitable roost trees will be avoided. Should adverse effects be identified during development of the final design, additional coordination with USFWS would be required.

Enlarge Embankment (C.3 in FEvR)

The effects to the bald eagle from implementing the Enlarge Embankment alternative would be the same as those listed for the Stabilize Foundation Soil with Drawdown alternative. Dredging from River Pond would require additional coordination with USFWS and KDWP to ensure that timing avoided impacts to eagles using the area and that the adjacent riparian area was not damaged. The Enlarge Embankment alternative would not preclude the implementation of Conservation Recommendations made by USFWS in their Biological Opinion.

4.2.3.2 Interior Least Tern

“No Action” Alternative

The “No Action” Alternative would have no effect on the Federally listed endangered interior least tern. There would be no new construction activity or change in the current operation of Tuttle Creek Lake. The Corps would continue to coordinate with the USFWS, KDWP and KWO to ensure that releases from Tuttle Creek Lake do not adversely impact nesting activities of the interior least terns, eggs and chicks, located on sandbars on the Kansas River, several miles downstream of Tuttle Creek Lake.

Under this alternative, there is a very remote possibility that Tuttle Creek dam could experience a seismic related failure and uncontrolled release of the Tuttle Creek pool. Should this event occur during the nesting season, June – August, all eggs/nests and/or unfledged interior least tern chicks located on the Kansas River several miles downstream of Tuttle Creek Lake would probably be destroyed. The duration for which interior least tern habitat would be inundated as a result of a seismic related failure is expected to be fairly short, 3 days. Depending on when this occurred during the nesting season, interior least tern could successfully re-nest, hatch and fledge young. As far as the direct effect on the interior least terns, this type event would be similar to the years when uncontrolled flows inundate the sandbars destroying nests and young. Unlike the typical higher flows that have affected the terns in the past, the large flow associated with the uncontrolled released of the Tuttle Creek pool, might scour vegetated bars that are currently unsuitable for nesting habitat or deposit material on existing bars or establish new bars. This could possibly result in the development of suitable nesting habitat for interior least tern, similar to what was observed after the 1993 flood.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would involve a permanent change from the current operation of Tuttle Creek Lake. This permanent change in operation could result in adverse effects on the Federally listed endangered interior least tern. There would be no new construction activity. The proposed change in operations would result in a reduced capacity of water that could be retained in Tuttle Creek Lake during the summer nesting season to prevent inundation of eggs and young located on Kansas River sandbars several miles downstream of Tuttle Creek Lake. This could result in more frequent losses of nests, located several miles downstream, due to inundation by more frequent releases from Tuttle Creek Lake. The Corps would continue to coordinate with the USFWS, KDWP and KWO to ensure that, to the greatest extent practicable and within the safe operating limits of the dam, releases from Tuttle Creek Lake do not adversely impact nesting activities of the interior least terns, eggs and chicks, located on sandbars on the Kansas River, several miles downstream of Tuttle Creek Lake. Because of the highly fluctuating pool, exposed areas adjacent to the lake would probably not supply additional suitable nesting habitat for the interior least tern. In addition, the ability to retain additional water in the early summer, in order to make high releases that increase levels on the Kansas River and encourages the birds to nest at the highest elevations in the suitable habitat, would be reduced. With these two exceptions, the Restricted Lake Operation alternative would not preclude the implementation of the Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take, or Conservation Recommendations made by USFWS in their Biological Opinion. Implementation of this alternative would require additional consultation with USFWS.

Under the Restricted Lake Operation alternative there is still a very remote possibility that Tuttle Creek dam could experience a seismic related failure and uncontrolled release of the Tuttle Creek pool. Effects of an uncontrolled release of

the Tuttle Creek pool on the Federally listed endangered interior least tern are described under the “No Action” alternative.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The Stabilize Foundation Soil with Drawdown alternative would have no effect on the Federally listed endangered interior least tern. This alternative would maintain the existing capability to retain water in Tuttle Creek Lake during the summer nesting season to prevent inundation of eggs and young located on Kansas River sandbars downstream of Tuttle Creek Lake. The Corps would continue to coordinate with the USFWS, KDWP and KWO to ensure that, to the greatest extent practicable and within the safe operating limits of the dam, releases from Tuttle Creek Lake do not adversely impact nesting activities of the interior least terns, eggs and chicks, located on sandbars on the Kansas River, several miles downstream of Tuttle Creek Lake. Interior least terns are not known to occur and no suitable habitat is found in the immediate construction area. The construction activity on the dam would have no effect on the interior least tern or their habitat. The ability to retain additional water in the early summer, in order to make high releases that increase levels on the Kansas River and encourage birds to nest at the highest elevations in the suitable habitat, would not be reduced. Upon completion of the construction activity, current multipurpose pool elevation and lake level management plan would be reinstated. The Stabilize Foundation Soil with Drawdown alternative would not preclude the implementation of the Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take, or Conservation Recommendations made by USFWS in their Biological Opinion.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

This alternative would involve no change in the current operation of Tuttle Creek Lake. Interior least terns are not known to occur and no suitable habitat is found in the immediate construction area. As such, the Stabilize Foundation Soil without Drawdown alternative would have no effect on the Federally listed endangered interior least tern or its habitat. Tuttle Creek Lake would continue to be operated in accordance with the existing Lake Regulation Manual and an elevation 1,075 ft., m.s.l. multi-purpose pool. This would maintain the existing capability to retain water in Tuttle Creek Lake during the summer nesting season to prevent inundation of eggs and young located on Kansas River sandbars several miles downstream of Tuttle Creek Lake. The Corps would continue to coordinate with the USFWS, KDWP and KWO to ensure that, to the greatest extent practicable and within the safe operating limits of the dam, releases from Tuttle Creek Lake do not adversely impact nesting activities of the interior least terns, eggs and chicks, located on sandbars on the Kansas River, several miles downstream of Tuttle Creek Lake. Interior least terns are not known to occur and no suitable habitat is found in the immediate construction area. The construction activity on the dam would have no effect on the interior least tern or their habitat. The ability to retain additional water in the early summer, in order to make high releases that increase levels on the Kansas River and encourage birds to nest at the highest elevations in the suitable habitat, would not be reduced. The Stabilize Foundation Soil without

Drawdown alternative would not preclude the implementation of the Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take, or Conservation Recommendations made by USFWS in their Biological Opinion.

Enlarge Embankment (C.3 in FEvR)

The effects of the Enlarge Embankment alternative on the Federally listed endangered interior least tern would be the same as those for the Stabilize Foundation Soil with Drawdown alternative. Implementation of this alternative would require additional consultation with USFWS.

4.2.3.3 Piping Plover

The Federally listed threatened piping plover and the Federally listed endangered interior least tern utilize the same Kansas River sandbar habitat during a similar summer nesting season, as such the Corps has determined that effects of the various alternatives to the piping plover would be the same as listed above for the interior least tern. Piping plovers are not known to occur and no suitable habitat is found in the immediate construction area.

4.2.3.4 Pallid sturgeon

The Corps believes that the alternatives being considered in this EIS would have no effect on the Federally listed endangered pallid sturgeon. In addition, the alternatives being considered in this EIS do not preclude the implementation of the Reasonable and Prudent Alternatives, Reasonable and Prudent Measures to Minimize Take, or Conservation Recommendations made by USFWS in their Biological Opinion.

4.2.3.5 State Listed Species

During coordination with the Kansas Department of Wildlife and Parks concerning the direct effects associated with proposed construction on the dam and potential drawdown of the lake, no potential effects on State listed threatened and endangered species or their critical habitat were identified.

4.3 Socio-Economic Environment

4.3.1 Development and Economy

Potential effects of the proposed project on the Development and Economy of the project area are discussed in Section 7-03 and 7-04 of the FEvR.

4.3.2 Public Safety

“No Action” Alternative (A. in FEvR)

As described in Section 1.3 Purpose and Need, the “No Action” alternative has the potential for loss of human life and serious property damage should a major seismic event occur in the project area. Even with the existing EAP, human loss of life would be expected as a result of failure of the Tuttle Creek Dam due to a major seismic event.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would lower the multi-purpose pool from the existing elevation of 1,075 ft., m.s.l. to elevation 1,050 ft., m.s.l. While this alternative would not prevent failure of the dam due to a major seismic event, the elevation 1,050 ft., m.s.l. was identified as an elevation that would minimize the potential for loss of human life and property damage. Since Tuttle Creek Lake would continue to be operated for flood control, there would be many times that the pool would be above the proposed multi-purpose pool elevation of 1,050 ft., m.s.l. Figure 8 shows that even when operating Tuttle Creek Lake with a multi-purpose pool elevation of 1,050 ft., m.s.l., the lake would be expected to be above that elevation approximately 40% of the time. Every time this occurred, the risk for loss of human life would be greater, and the higher the pool the greater the risk should a major seismic event occur. The Dam Failure Warning System and Evacuation Plan described in Section 7., that would be an interim measure under the construction alternatives, would be a permanent component of the Restricted Lake Operation alternative to increase public safety for times when the pool was above elevation 1,050 ft., m.s.l. Considering the requirements for protection of human life, the Corps believes that this alternative would not be consistent with our current Dam Safety Regulations.

Since the Restricted Lake Operation alternative does not prevent major seismic damage to Tuttle Creek Dam, should this occur, flood control capability would be lost until the dam could be restored, probably requiring several years.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

Upon completion of construction of the Stabilize the Foundation Soil with Drawdown alternative, Tuttle Creek Dam would be expected to survive a major seismic event and be capable of continuing its existing operations after inspection and expected minor repairs. There would be no failure of the dam or related loss of human life or property damage. The flood control capability of the dam would not be affected. Considering the requirements for protection of human life, minimizing property damage, and continuing operation of the project, the Corps believes that this alternative would be consistent with our current Dam Safety Regulations.

Under this alternative the Dam Failure Warning System and Evacuation Plan described in Section 7. would be an interim measure for the 7-10 year construction period to increase public safety for times when the pool was above elevation 1,050 ft., m.s.l.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown would provide the same post construction benefits to public safety as the Stabilize the Foundation Soil with Drawdown and Enlarge Embankment alternatives. Considering the requirements for protection of human life, minimizing property damage, and continuing operation of the project, the Corps believes that this alternative would be consistent with our current Dam Safety Regulations.

This alternative would also include Dam Failure Warning System and Evacuation Plan described in Section 7. as an interim measure for the 7-10 year construction period to increase public safety. This alternative would not include a lake drawdown. The pool would continue to be operated with a multi-purpose pool elevation of 1,075 ft., m.s.l. and would be above the elevation 1,050 ft., m.s.l. during the entire 7-10 year construction period. In addition, as the pool would continue to be operated for flood control and endangered species, there would be many times that the pool would be above the multi-purpose pool elevation of 1,075 ft., m.s.l.

Enlarge Embankment (C.3 in FEvR)

Same as the Stabilize Foundation Soil with Drawdown alternative.

4.3.3 Transportation

This section specifically addresses the project related effects on road transportation in the project area. No effects were identified for rail or air transportation facilities. Boating is addressed in Section 4.3.7.3 and Navigation is addressed in Section 4.3.4.

“No Action” Alternative (A. in FEvR)

The “No Action” Alternative would involve no construction activity or change in project operation. Therefore it would have no effect on transportation in the project area.

Should a major seismic event result in failure of the dam and the uncontrolled loss of the Tuttle Creek pool, State Route 13 across the crest of Tuttle Creek Dam would be destroyed and out of service until such time as the dam and roadway could be restored. This would probably require several years of construction activity, which would further affect transportation in the immediate project area. Roadways downstream of Tuttle Creek Dam in the inundated area could be affected at varying levels from simply loss of use from the inundation, to damage resulting from the high velocity flows.

3630 **Restricted Lake Operation (B.4 in FEvR)**

3631
3632 The Restricted Lake Operation alternative involves only a change in the
3633 current operation of the project and includes no construction activity. There would
3634 be no effects on transportation.

3635
3636 Like the “No Action” alternative, should a major seismic event result in failure
3637 of the dam and the uncontrolled loss of the Tuttle Creek pool, State Route 13
3638 across the crest of Tuttle Creek Dam would be destroyed and out of service until
3639 such time as the dam and roadway could be restored. This would probably require
3640 several years of construction activity, which would further affect transportation in the
3641 immediate project area. Although damage to downstream transportation facilities
3642 would be expected to be less than under the “No Action” alternative because of the
3643 reduced pool size, roadways downstream of Tuttle Creek Dam in the inundated
3644 area could still be affected at varying levels from simply loss of use from the
3645 inundation, to damage resulting from the high velocity flows.

3646
3647 **Stabilize Foundation Soil with Drawdown (C.2 in FEvR)**

3648
3649 Large trucks would be bringing equipment and supplies, in particular the
3650 large amount of cement needed to construct the project, through the City of
3651 Manhattan to the proposed construction site at Tuttle Creek Dam. The proposed
3652 route of travel would be from I-70, north on U.S. 77, through Manhattan, and then
3653 east on State Route 13 to the construction site. Currently we estimate that this
3654 would add approximately 20 tractor/trailer vehicles and 20 large commercial
3655 vehicles per day to the existing traffic on these roadways. Currently these
3656 roadways are open to commercial truck traffic as discussed in Section 3.3.5 above.
3657 For reference, the highway across the dam experiences approximately 5,280
3658 vehicles daily including 365 heavy commercial vehicles.

3659
3660 Considering the existing amount and type of traffic on these roadways, we do
3661 not believe that the minor increases in commercial truck traffic associated with
3662 moving construction equipment and material through the City of Manhattan to the
3663 construction site would adversely affect the existing transportation system. Although
3664 a significant impact to the roadways in the Manhattan/Riley County area is not
3665 anticipated from this action, roadway monitoring in the immediate vicinity of the
3666 project and coordination with Riley County and Kansas Department of
3667 Transportation will be performed. Where new entrances or upgrades are required
3668 on public rights-of-way, the proper realty rights and permits will be acquired from the
3669 respective public entity.

3670
3671 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

3672
3673 Same as Stabilize the Foundation Soil with Drawdown.

Enlarge Embankment (C.3 in FEvR)

Very similar to the Stabilize the Foundation Soil alternatives, but since a much lower quantity of cement is needed, truck traffic through Manhattan would be less.

4.3.4 Navigation

“No Action” Alternative

The “No Action” Alternative would have no effect on navigation releases from Tuttle Creek Lake. There would be no construction or changes in operation.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur the capability to support navigation with releases from Tuttle Creek Lake would be lost until such time as the dam could be restored and the lake returned to the multipurpose pool elevation.

Restricted Lake Operation (B.4 in FEvR)

The proposed operation at a multipurpose pool elevation of 1,050 ft., m.s.l. is well below the lower limit established in the current Lake Regulation Manual for supplemental navigation releases.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The effects of the Stabilize the Foundation Soil with Drawdown would be the same as the Restricted Lake Operation except the change in operation would be restricted to a 7-10 year construction period.

Upon completion of construction and return to the multipurpose pool elevation 1,075 ft., m.s.l., navigation support would continue at existing levels. Even if a major seismic event occurred in the project area, Tuttle Creek Dam/Lake would be expected to continue providing navigation support at the existing level after inspection and expected minimal repairs.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown alternative would involve no drawdown or change in project operation during the 7-10 year construction period. Therefore this alternative would have no effect on the capability of Tuttle Creek Lake to fulfill the existing level of supplemental flow for navigation support. Like the other construction alternatives, after construction is complete Tuttle Creek Dam/Lake would be expected to survive a major seismic event and continue providing navigation support at the existing level after inspection and expected minimal repairs.

Enlarge Embankment (C.3 in FEvR)

The effects of the Enlarge Embankment alternative on navigation would be the same as those described under the Stabilize Foundation Soil with Drawdown alternative.

4.3.5 Utilities/Water supply

“No Action” Alternative (A. in FEvR)

Under the “No Action” alternative there would be no construction or change in project operation. Therefore there would be no effects on utilities or water supply.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur the water supply capability of Tuttle Creek Lake would be lost until such time as the dam could be restored.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would involve the permanent lowering of Tuttle Creek Lake to a new multi-purpose pool elevation of 1,050 ft., m.s.l. which is 25 feet lower than the existing multipurpose pool elevation of 1,075 ft., m.s.l. The Corps utilized historic inflow data and applied operation of the pool at this new elevation to understand what effects operation at the proposed multipurpose pool elevation would have on water supply. A comparison of the existing operation and proposed 1,050 multipurpose pool operation is provided in Figure 8. Existing water supply needs would usually be fully met by Tuttle Creek Lake in most years, operating with the elevation 1,050 ft., m.s.l. multipurpose pool. However, even mild droughts would result in severe drawdowns of the lake. Looking at the winter of 1991-1992, Tuttle Creek Lake would have been drawn down 30 feet to elevation 1,020 ft., m.s.l. Water supply would account for 27 feet of this drawdown, with water quality accounting for only 3 feet. During severe droughts like that experienced in the early 1950s, Tuttle Creek Lake would only be partially emptied if operating at the elevation 1,075 ft., m.s.l. multipurpose pool. Under the proposed 1,050 ft., m.s.l. multipurpose pool elevation the pool would be completely drained in 2 of 5 years of the drought as a result of withdrawals for water supply and water quality. Although capable of supporting water supply in most years, these extreme drawdowns would have very serious adverse effects on many other resources associated with Tuttle Creek Lake. This alternative could also require the extension of outfalls entering Tuttle Creek Lake.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The Stabilize the Foundation Soil with Drawdown would have the same effect on utilities and water supply as the Restricted Lake Operation alternative. These effects would be restricted to the 7-10 year construction period. Upon completion of construction, the pool would return to operation with the existing elevation 1,075 ft.,

m.s.l. multipurpose pool, and continue to meet the existing water supply commitments. The dam would be expected to survive a major seismic event, and after inspection and expected minor repairs, continue to provide the existing level of water supply.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize Foundation Soil without Drawdown alternative would have no effect on utilities or the capability of Tuttle Creek Lake to meet existing water supply commitments during construction. Upon completion of construction, the dam would be expected to survive a major seismic event and, after inspection and expected minor repairs, continue to provide the existing level of water supply.

Enlarge Embankment (C.3 in FEvR)

The Enlarge Embankment alternative would result in similar effects to utilities and water supply as the Stabilize Foundation Soil with Drawdown alternative.

4.3.6 Flood control

“No Action” Alternative

The “No Action” Alternative would have no effect on the flood control capability of Tuttle Creek Lake. There would be no construction or changes in operation.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur the flood control capability of Tuttle Creek Lake would be lost until such time as the dam could be restored.

Restricted Lake Operation (B.4 in FEvR)

The operation of Tuttle Creek Lake for flood control would be very slightly enhanced by the Restricted Lake Operation Alternative.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur the flood control capability of Tuttle Creek Lake would be lost until such time as the dam could be restored.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

During the 7-10 year construction period, the Stabilize the Foundation Soil with Drawdown alternative would result in a very slight increase in the flood control capability of Tuttle Creek Lake.

The Corps utilized historic inflow data and applied operation of the pool at the proposed 1,050 ft., m.s.l. elevation to determine what benefits to construction cost could be achieved by operating the pool at a lower elevation. Inundation of the work platform would halt work on the upstream face of the dam and cause the contractor to demobilize equipment, wait until lake level dropped below the work platform, and then remobilize equipment. These actions could result in a substantially increased cost in the overall project over a 7-10 year construction period. Comparing the existing operation and proposed 1,050 multipurpose pool operation, as shown in Figure 9. Tuttle Creek pool would be expected to be above the top of the work platform 19% of the time operating at the current 1,075 ft., m.s.l. elevation and 17% of the time at the proposed 1,050 ft., m.s.l. operation. This 2% difference would represent an estimated cost increase of approximately \$3 million in the overall project.

Long-term, after construction, Tuttle Creek Lake would be capable of the existing level of flood control minus the effects of sedimentation and the construction berm across the face of the dam. Should a major seismic event occur after construction, the dam would be capable of continuing operation for flood control at the existing level after inspection and expected minimal repairs.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

During the 7-10 year construction period, under the Stabilize the Foundation Soil without Drawdown alternative, the flood control capability of Tuttle Creek Lake would be maintained at the current level. As noted under Stabilize Foundation Soil with Drawdown, costs associated with increased flooding of the work platform would increase project costs an estimated \$3 million.

Long-term, after construction, Tuttle Creek Lake would be capable of the existing level of flood control minus the effects of sedimentation and the construction berm across the face of the dam. Should a major seismic event occur after construction, the dam would be capable of continuing operation for flood control at the existing level after inspection and expected minimal repairs.

Enlarge Embankment (C.3 in FEvR)

Effects of the Enlarge Embankment alternative would be similar to Stabilize the Foundation Soil with Drawdown. The main difference being that very minor flood control capacity would be lost as a result of the construction of the large berm on the upstream face of the dam.

4.3.7 Recreation

As described under 3.3.9 Recreation (Affected Environment) there is extensive recreational development and high use of the recreational areas at Tuttle Creek Lake. The Kansas Department of Wildlife and Parks operates recreation areas adjacent to Tuttle Creek Lake under license agreement with the Corps. In addition, the Corps operates recreation facilities at Tuttle Creek Lake. In order to

gain a better understanding of how alternatives being considered in the Dam Safety Assurance Program could potentially affect recreation at Tuttle Creek Lake, the Corps coordinated with the Kansas Department of Wildlife and Parks concerning what potential effects construction activity on the dam and lake drawdown would have on KDWP operated recreation areas at Tuttle Creek Lake. In a letter dated March 4, 2002 (included as Appendix B) KDWP provided the Corps with an assessment of potential effects on KDWP operated recreation areas of pool drawdown and construction activity on the dam. Alternatives that involve construction on the dam would have the greatest effect on areas downstream at River Pond State Park and the Outlet Park. Facilities within these areas are shown in Figure 7. All of the area downstream of Tuttle Creek Dam is included in the River Pond State Park and has been designated by the Kansas Department of Wildlife and Parks as National Park Service Land & Water Conservation Fund 6(f) property. Any options that impact the area downstream of the dam would need to address this encumbrance on the property. Alternatives that involve a temporary or permanent drawdown would affect upstream recreation use and facilities. Figure 6 shows the surface area of Tuttle Creek Lake at elevation 1,050 ft., m.s.l. compared to the current multipurpose pool elevation of 1,075 ft., m.s.l. The following sections provide information on the effects of the various alternatives on Corps and KDWP operated recreation areas. In addition, potential mitigative measures are described for each alternative. The following provides a summary statement comparing the effect on recreation of the various alternatives. A detailed description of effects and potential mitigation for specific recreation activities follows this summary.

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity or change in project operation. Therefore this alternative would have no effect on recreation at Tuttle Creek Lake.

Under the “No Action” alternative there is the remote possibility of a seismic related dam failure at Tuttle Creek Lake. Should this occur, recreation facilities upstream would be affected by loss of the pool until such time as the dam could be restored and the lake returned to normal level. Recreation facilities in the downstream area would be damaged by the uncontrolled release of the pool and affected by the following cleanup and dam restoration activity.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation Alternative would avoid all impacts to the downstream recreation areas/users at River Pond State Park and Outlet Area. Recreation areas/users on the main lake would experience serious long-term adverse impacts as a result of the permanently lowered pool elevation. Continuing operation of the lake for flood control would result in greater fluctuation in the lake level when compared to the no action alternative. Fisheries resources would experience serious declines affecting recreational fishing opportunities. Many of the existing recreation facilities would require modification to provide continued

3916 service at the lowered pool elevation. This alternative would have the greatest
3917 adverse effect on recreation at Tuttle Creek Lake.

3918
3919 In addition, under the Restricted Lake Operation alternative there is still the
3920 remote possibility of a seismic related dam failure at Tuttle Creek Lake. Should this
3921 occur, recreation facilities upstream would be affected by loss of the pool until such
3922 time as the dam could be restored and the lake returned to normal level.
3923 Recreation facilities in the downstream area would be damaged by the uncontrolled
3924 release of the pool and affected by the following cleanup and dam restoration
3925 activity.

3926 3927 **Stabilize Foundation Soil with Drawdown (C.2 in FEvR)**

3928
3929 The Stabilize Foundation Soil with Drawdown alternative would have the
3930 same effect on upstream recreation facilities/users as the Restricted Lake Operation
3931 alternative. Instead of being a permanent change in operation, these effects would
3932 occur during the 7-10 year construction period. This alternative would still involve
3933 the direct construction effects to recreation users/facilities at the River Pond State
3934 Park and Outlet Park. Mitigative measures would be designed to offset direct
3935 construction impacts to downstream recreation facilities/users. Upon completion of
3936 construction, recreation could return to the existing level.

3937 3938 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

3939
3940 Of the three construction alternatives being considered, Stabilize the
3941 Foundation Soil without Drawdown would have the least effect on recreation at
3942 Tuttle Creek Lake. This alternative would still involve the direct construction effects
3943 to recreation users/facilities at the River Pond State Park and Outlet Park. It would
3944 avoid effects to upstream recreation areas/users associated with a lake drawdown
3945 for a 7-10 year construction period. Mitigative measures would be designed to offset
3946 direct construction impacts to downstream recreation facilities/users. Upon
3947 completion of construction, recreation could return to the existing level.

3948 3949 **Enlarge Embankment (C.3 in FEvR)**

3950
3951 The effects of the Enlarge Embankment alternative, which includes a lake
3952 drawdown for the 7-10 year construction period, would be very similar to the
3953 Stabilize Foundation Soil with Drawdown alternative. The main difference being
3954 that the large berms would extend farther into the lake on the upstream side and
3955 into the River Pond State Park on the downstream side than the smaller
3956 construction berms needed for the Stabilize Foundation Soil alternatives. Mitigative
3957 measures would be the same as Stabilize the Foundation Soil with Drawdown
3958 alternative. Upon completion of construction, recreation could return to the existing
3959 level.

4.3.7.1 Hunting

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to hunting would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, hunting of waterfowl at Tuttle Creek Lake and all hunting activities on the inundated area on the Kansas River floodplain would be adversely affected. Waterfowl hunting at Tuttle Creek Lake would be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation. Depending on timing, less mobile wildlife or young could be seriously affected by the inundation of the floodplain. This could reduce populations of game and non-game species and reduce hunting opportunities. Wildlife habitat on the inundated areas of the Kansas River floodplain would be expected to recover fairly quickly.

Restricted Lake Operation (B.4 in FEvR)

Coordination with KDWP and USFWS identified potential adverse effects to waterfowl hunting as one major concern with any alternative that included a permanent or temporary construction drawdown of Tuttle Creek Lake. Permanent lowering of the lake could potentially adversely affect the water supply of the constructed marsh areas adjacent to Tuttle Creek Lake (Fancy Creek Marsh, Swede Creek Marsh, Timber Creek Marsh, Black Vermillion Marsh).

Potential mitigation measures that were identified to continue operation of these marsh areas at their current level with a permanent or temporary lake drawdown included construction of portable pump pads, permanent wells, and treating the soils within the wetland areas to decrease permeability.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

During the 7-10 year construction period the adverse effects associated with the Stabilize Foundation Soil with Drawdown alternative would be very similar to the Restricted Lake Operation alternative. Upon completion of construction and return of the lake to the multipurpose pool elevation of 1,075 ft., m.s.l., hunting opportunities would be expected to return to existing levels. Potential mitigation measures would be the same as under the Restricted Lake Operation alternative.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

No adverse effects to hunting would be expected as a result of the Stabilize Foundation Soil without Drawdown alternative.

Enlarge Embankment (C.3 in FEvR)

The effects on hunting associated with the Enlarge Embankment alternative would be the same as those described for the Stabilize Foundation Soil with Drawdown alternative.

4.3.7.2 Fishing

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to fishing would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, fishing at Tuttle Creek Lake and downstream on the Big Blue River, Kansas River and River Pond would be adversely affected. The most severe effects would be at Tuttle Creek Lake, which would be adversely affected until such time as the dam could be restored, the lake returned to the multipurpose pool elevation, and the lake fishery restored. Effects to fisheries resources downstream of Tuttle Creek Lake would be considered temporary and expected to recover more quickly.

Restricted Lake Operation (B.4 in FEvR)

As described above in Section 4.2.2 Aquatic Ecosystem, the Restricted Lake Operation alternative would have serious adverse long-term effects on the fisheries resource at Tuttle Creek Lake. This would result in a corresponding adverse effect on recreational fishing at Tuttle Creek Lake. In addition, as described in Section 4.3.7.3 Boating, there would be greater fluctuation in lake levels and reduced access to the lake from the existing boat ramps. Access for shoreline fisherman would also be adversely affected as the lakeshore would typically be a greater distance from existing parking areas and roadways. In addition, shoreline fishermen would often have to cross large mudflats to access the lakeshore.

Overall lower fish population in Tuttle Creek Lake could result in lower numbers of fish in River Pond and the Outlet Area as there would be fewer fish available to move through the conduits during high releases. This effect could possibly extend as far downstream as the Rocky Ford State Fishing Area and the Kansas River.

The Restricted Lake Operation alternative would have no effect on KDWP's put and take trout fishery located in the relief well collector ditch at River Pond State Park. Outflow from the relief well collector system would not be expected to be significantly reduced under this alternative.

Because of the permanent change in operation, KDWP and USFWS both commented that mitigative measures necessary to maintain a viable fishery at Tuttle Creek Lake under the Restricted Lake Operation alternative would require extensive stockings, to even include adult size fish. These stocking would not be a one time supplement to the existing fishery resource after initial drawdown, but would probably be required on a routine basis for the remaining life of the project.

Under this alternative there is still the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, fishing at Tuttle Creek Lake and downstream on the Big Blue River, Kansas River and River Pond would be adversely affected. The most severe effects would be at Tuttle Creek Lake, which would be adversely affected until such time as the dam could be restored, the lake returned to the multipurpose pool elevation, and the lake fishery restored. Effects to fisheries resources downstream of Tuttle Creek Lake would be considered temporary and the resources expected to recover more quickly.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The temporary construction lake drawdown component of the Stabilize Foundation Soil with Drawdown alternative would have the same effect on fishing and fisheries resources at Tuttle Creek Lake as the Restricted Lake Operation alternative. These effects, although not permanent, would be fairly long term, occurring over a 7-10 year construction period. As described in Section 4.2.2 Aquatic Ecosystem, in order to mitigate these effects, the Corps would coordinate with KDWP to develop a fisheries plan for Tuttle Creek Lake, and fund stocking of fish to maintain the existing fishery resource through completion of construction. In addition, the Corps would coordinate with KDWP to refill the pool in a manner that maximizes benefits to the fishery resource and takes advantage of any shoreline vegetation that develops during the construction period. Mitigative measures for boating and marina access are described in 4.3.7.3 Boating and 4.3.7.10 Recreation Related Businesses.

During construction work on the upstream face of the dam certain areas would be restricted from use by shoreline fishermen. Fishing access to the Big Blue River channel in Outlet Park and River Pond in River Pond State Park would be maintained during the 7-10 year construction period.

Construction of the positive cut-off would eliminate the KDWP's existing put and take trout fishery located in the relief well collector ditch at River Pond State Park. Lack of cool water coming from the relief well collector system will eliminate the year round put and take fishing opportunity. This resource has been available to fishermen since 1994. KDWP has suggested that appropriate mitigation for loss of the existing resource could include construction of an approximately 2 acre pond that would be used as a cool season put and take trout fishery and operated for youth fishing during the warmer months. KDWP has suggested a location at the northeast corner of River Pond for a 2-acre constructed pond. In order to mitigate for project related effects on KDWP's existing put and take trout fishery, the Corps

will coordinate with KDWP to create a new trout pond in River Pond State Park. The Corps believes that construction of a new trout pond can be accomplished as part of the initial construction activity. The Corps will try to minimize the time between the construction activity that effects the existing resource and availability of the new facility.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize Foundation Soil without Drawdown would have the least effect on fishing at Tuttle Creek Lake of all alternatives being considered with the exception of the "No Action" alternative. Effects of the 7-10 year construction drawdown on fishing would be avoided under this alternative. Effects on downstream areas in River Pond State Park and Outlet Park would be the same as those described for Stabilize Foundation Soil with Drawdown. Proposed mitigation for put and take trout fishery would be the same as for Stabilize Foundation Soil with Drawdown. In addition, floating silt curtains adjacent to the construction area on the face of the dam would restrict boat access for fisherman in these areas.

Enlarge Embankment (C.3 in FEvR)

The effects on fishing associated with the Enlarge Embankment alternative would be the same as those described for the Stabilize Foundation Soil with Drawdown alternative.

4.3.7.3 Boating

"No Action" Alternative (A. in FEvR)

The "No Action" alternative would involve no construction activity and no change in project operations, therefore no impacts to boating would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, boating at Tuttle Creek Lake and downstream on the Big Blue River, Kansas River and River Pond would be adversely affected. The most severe effects would be at Tuttle Creek Lake, which would be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation. Adverse effects to boating on areas downstream of Tuttle Creek Lake would be considered short term and temporary.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would involve the permanent lowering of the pool from the existing multipurpose pool elevation of 1,075 ft., m.s.l. to the proposed multipurpose pool elevation of 1,050 ft., m.s.l. This would result in serious adverse impacts to boaters using Tuttle Creek Lake. None of the existing boat ramps would be serviceable at that elevation. In addition, at their current

location, the marina in Spillway State Park, the Blue Valley Yacht Club facilities, and the Kansas State University rowing team facility would not be fully operational at that elevation. In order to mitigate the effects of pool lowering, this alternative would require extension of the existing boat ramps and possibly construction of new ramps. In addition, these boating facilities may have to be relocated to an area where they would be operational at the new lower multipurpose pool elevation. Tuttle Creek Lake would continue to be used for flood control and there would be more fluctuation in the pool than is currently experienced. Existing boating facilities including the marina in Spillway State Park, the Blue Valley Yacht Club facilities, and the Kansas State University rowing team facilities would need to be modified so that they can function under greater variation in the elevation of the pool. Permanent lowering of the lake could expose additional boating hazards that are currently well below the multi-purpose pool elevation. The Corps would have to survey the lake to determine if any of these hazards would require removal or marking with buoys. Existing lake buoys would have to be adjusted to operate with greater fluctuation in the pool.

This alternative would have no effect on boating activity in the downstream areas at River Pond State Park, the Big Blue and Kansas Rivers.

Under this alternative there is still the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, boating at Tuttle Creek Lake and downstream on the Big Blue River, Kansas River and River Pond would be adversely affected. The most severe effects would be at Tuttle Creek Lake, which would be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation. Adverse effects to boating on areas downstream of Tuttle Creek Lake would be considered short term and temporary.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The temporary construction lake drawdown component of the Stabilize Foundation Soil with Drawdown alternative would have the same effect on boating at Tuttle Creek Lake as the Restricted Lake Operation alternative. Mitigation measures such as extending boat ramps and relocation of the marina would also be the same. These effects although not permanent, would be fairly long term occurring over a 7-10 year construction period. The direct construction activity on the dam would have no effect on boating. Use of the existing road on the downstream left abutment for construction access will limit public access to River Pond State Park. Although minimally reduced, access to boating facilities at River Pond would not be eliminated.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown alternative would have the least effect on boating at Tuttle Creek Lake of all alternatives considered with the exception of the "No Action" alternative. There would be no drawdown

associated effects on boating in Tuttle Creek Lake. There would be short term minor effects on boating associated with the floating silt curtains that will be used along the face of the dam during construction of the work platform. Effects on boating in the downstream area in River Pond would be the same as those described for Stabilize Foundation Soil with Drawdown.

Enlarge Embankment (C.3 in FEvR)

The effects on boating associated with the Enlarge Embankment alternative would be the same as those described for the Stabilize Foundation Soil with Drawdown alternative.

4.3.7.4 Swimming

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to swimming or beach facilities at Tuttle Creek Lake would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, swimming at Tuttle Creek Lake, and swimming and beach facilities at River Pond State Park would be adversely affected. Swimming at Tuttle Creek Lake would be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation. Swimming and beach facilities at River Pond State Park could probably be restored more quickly.

Restricted Lake Operation (B.4 in FEvR)

The proposed permanent change in multi-purpose pool elevation from 1,075 ft., m.s.l. to 1,050 ft., m.s.l. would adversely affect the existing swim beach facility at Tuttle Creek Cove Park. This could require reconstruction of the extension or relocation of the existing beach area.

The Restricted Lake Operation Alternative would have no effect on the swim beach in River Pond State Park.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The effects on swimming/beach facility at Tuttle Creek Cove Park would be the same as under the Restricted Lake Operation alternative during the 7-10 year construction period when the lake is drawn down to elevation 1,050 ft., m.s.l.

Construction activity on the downstream side of the dam would not prevent access to the swim beach facility at River Pond State Park. Since the existing access road on the downstream left abutment will be utilized solely for construction

access, access to this swim beach will be limited. Dredging in River Pond would create noise and visual impacts for swimmers using the beach at River Pond State Park. In addition, increased turbidity as a result of the dredging operation would affect swimmers using the area. These effects could be avoided by conducting the dredging operation outside the summer recreation season when high use of the swim beach would be expected.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize Foundation Soil without Drawdown alternative would have no affect on swimming or beach facilities at Tuttle Creek Cove Park or at the undeveloped natural beach area near Broken Arrow Ranch.

Construction activity on the downstream side of the dam would not prevent access to the swim beach facility at River Pond State Park. Since the existing access road on the downstream left abutment will be utilized solely for construction access, access to this swim beach will be through a new park entrance off of Dyer Road. Dredging in river pond could create noise and visual impacts for swimmers using the beach at River Pond State Park. In addition, increased turbidity as a result of the dredging operation could affect swimmers using the area. These effects could be avoided by conducting the dredging operation outside the summer recreation season when high use of the swim beach would be expected.

Enlarge Embankment (C.3 in FEvR)

The effects on swimming associated with the Enlarge Embankment alternative would be the same as those described for the Stabilize Foundation Soil with Drawdown alternative.

4.3.7.5 Camping/Hiking

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to camping and hiking at Tuttle Creek Lake would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, camping and hiking would be most severely affected at River Pond State Park. These adverse effects would be fairly short term until facilities and services in the area could be restored. The main adverse effect to camping and hiking on areas upstream and adjacent to Tuttle Creek Lake would be the adverse aesthetic impacts associated with loss of the lake viewscape, and the replacement with a view of the lake bottom area devoid of vegetation. These activities would continue to be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would have the greatest effect on camping and hiking on areas adjacent to Tuttle Creek Lake upstream of the dam. The Restricted Lake Operation alternative in itself would not directly affect any camping and hiking facilities at Tuttle Creek Lake. Probably the greatest effect this change in operation would have comes from the adverse aesthetics associated with the lowered pool. This may cause hikers and especially campers to use alternate sites at other lakes/parks or the facilities located downstream of Tuttle Creek Dam. Outside of this possible increased use, River Pond State Park would not be affected by the Restricted Lake Operation alternative. .

Under this alternative there is still the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, camping and hiking would be most severely affected at River Pond State Park. These adverse effects would be fairly short term until facilities and services in the area could be restored. The main adverse effect to camping and hiking on areas upstream and adjacent to Tuttle Creek Lake would be the adverse aesthetic impacts associated with loss of the lake viewscape and the replacement with a view of the lake bottom area devoid of vegetation. These activities would continue to be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The Stabilize Foundation Soil with Drawdown alternative would have the same drawdown related effects on camping and hiking at Tuttle Creek Lake as the Restricted Lake Operation alternative. These effects, although not a permanent change, would be fairly long term considering the 7-10 year construction period.

In addition, the proposed construction activity on the dam would have serious adverse effects on campers using the area at River Pond State Park. The close proximity of the construction area to the existing campground

The following paragraphs described the mitigation proposed to offset direct effects of the proposed construction activity on camping and hiking.

Campers in River Pond State Park are expected to be impacted to some degree by construction noise. To offset noise impacts as well as physical conflicts with construction, replacement camping facilities will be constructed. A similar number of sites to those impacted by construction activities will be constructed or upgraded in River Pond State Park, south of the River Pond, and in the Tuttle Creek Cove area to offset the impact to campsites closest to the dam. The existing 34 sites on the peninsula extending south into the River Pond area will be rehabilitated to fully accommodate late model recreation vehicles. These sites are considered to be far enough from the work area that the impacts of the work will not be significant. The number of sites that will exist in the area after the rehabilitation is dependent

upon the available space and exact design layout. However, it is anticipated that the final number of sites will be something less than 34. New header ditch crossings will be constructed to facilitate new traffic flow patterns resulting from these modifications.

The River Pond State Park will be expanded south of the River Pond with the construction of approximately 50 replacement sites. The sites will be a mix of full utility sites that will accommodate late model recreational vehicles as well as more limited sites to accommodate smaller vehicles. The exact configuration and mix of the sites is dependent upon the final design layout and space limitations. The area to be utilized includes the open area of a current K-State license and the wooded area immediately south of the southwest corner of the River Pond. A shower building and dump station will be constructed south of the River Pond to support these camp sites. The dump station will either connect to the existing lagoon or a new lagoon facility will be constructed. The area being proposed for campgrounds contains several large trees that could potentially be used as roost trees for bald eagles. No large roost trees will be removed or impacted. Additionally, the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service have agreed to close this campground in the winter to avoid potential impacts to bald eagles using the area.

Construction of a new campground with approximately 40 sites is proposed for the Tuttle Cove draw area to offset the loss of use of campsites below the dam. These facilities will be located above all but the most extreme pool level fluctuations. Due to the nature of the terrain and access to the area, these facilities will not be as attractive to late model recreational vehicle owners as the sites in River Pond State Park. The Tuttle Cove replacement facilities will include associated comfort station upgrades, toilet facilities, day use facilities, expanded boat ramp and general modifications associated with the replacement camping facilities. The replacement facilities will be constructed in compliance with the Americans with Disabilities Act.

The development of new or upgraded facilities in the Spillway State Park area is not proposed.

Tuttle Cove and the area downstream of the River Pond are considered to be close enough to the River Pond and Outlet Park areas that displaced visitors are likely to use the replacement facilities. These sites are far enough away from the construction area that the noise and construction impacts will be minimal or eliminated. Construction of replacement facilities is not considered practicable in the other existing park areas of Tuttle Creek Lake, namely Carnahan, Stockdale, Fancy Creek, and Randolph Park areas due to the distance these parks are located from the River Pond and Outlet Parks.

The day use area occupied by Shelters 3 and 4 will be unusable during construction due to the extreme proximity to the construction area. Impacts to these two shelters will be offset by improving other park shelters in the area by replacing the shelters in their entirety and/or the lost amenities of these shelters. This may

include construction of additional playgrounds, water, and toilet facilities in the Outlet Park, Spillway Park, and/or Tuttle Cove Park areas. It is likely that both Shelter 3 and 4 will be destroyed during construction and replacement at their existing location will be required upon construction completion.

The nature trail system below the dam will be impacted by the project. The trailhead of the nature trail in the old river channel will be inaccessible during construction and impacted the most. An alternate access point to this trail will be provided by extending the trail in the River Pond State Park across the old river channel by construction of a foot bridge to reach the area. In addition, a trail will be constructed at the Observation Point area to offset trail impacts below the dam. The existing Cedar Ridge Trail in Spillway Park will also be available to displaced trail users from River Pond and/or Outlet Park trails.

Since significant heavy equipment traffic will exist on and adjacent to the dam, traffic patterns will be adjusted and new roads will be constructed to completely avoid camping and day use traffic conflicts with construction equipment. The area within a few hundred feet of the road downstream of the dam will be off-limits to the public (except for special events). The existing public access to the downstream side of the dam from the west will be maintained by connecting the toe road east of the tubes to the park road just east of the wetland area. Header ditch crossings will be constructed to accommodate the new traffic pattern as required. Both sides of the outlet area (tubes) and the day use area downstream of the stilling basin on the east side of the outlet works will remain open to the public. Day use activities including fishing and picnicking are conducted in this area. Impacts to these areas are considered to be minimal.

The road leading from the east end of the dam, past the radio-controlled flying field and to the downstream side of the dam will be closed to the public at Highway 13 and will be used for construction traffic only. Access to the radio-controlled flying field will be maintained through the downstream River Pond road network.

To provide access to the downstream area including the existing and new areas of River Pond State Park, a new River Pond park entrance with appropriate signage and an entrance station will be constructed leading north from Dyer Road at the southeast corner of the park. Details of the intersection of the new entrance road with Dyer Road will be evaluated to ensure traffic safety. The new entrance road will follow the former alignment of the county road in this area. This road will cross the spillway alignment and will be sacrificial (at the Corps of Engineers' cost) if a spillway discharge occurs. The Corps of Engineers will own and maintain this road. A barrier will also be constructed along one side of this road to avoid conflicts with the Spillway Cycle area. Construction of new interior park roads and header ditch crossings will be necessary to connect all portions of the River Pond State Park to this new entrance. Existing park roads leading north to the dam will be blocked with pipe gates or by other means to allow emergency access but prevent conflicts with heavy equipment. These changes are anticipated to be permanent.

Informational kiosks explaining the dam safety construction program will be constructed at each end of the dam, the scenic overlook, and in the River Pond State Park to explain the construction.

The radio controlled flying field area will remain at its current location. Access to the radio-controlled flying field will be modified but maintained through the downstream River Pond road network.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize the Foundation Soil without Drawdown alternative would avoid the drawdown related effects on camping and hiking at Tuttle Creek Lake.

The effects of the construction activity and proposed mitigation would be the same as described for the Stabilize Foundation Soil with Drawdown alternative.

Enlarge Embankment (C.3 in FEvR)

The effects on camping and hiking associated with the Enlarge Embankment alternative would be the same as those described for the Stabilize Foundation Soil with Drawdown alternative. In addition, the large berm on the downstream side of the dam would permanently effect the existing camping area at River Pond State Park. Proposed mitigation would be the same as described for the Stabilize Foundation Soil with Drawdown alternative.

4.3.7.6 Picnicking

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to picnicking at Tuttle Creek Lake would be expected.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, picnicking facilities and areas would be most severely affected at River Pond State Park. These adverse effects would be fairly short term until facilities and services in the area could be restored. The main adverse effect to picnicking on areas upstream and adjacent to Tuttle Creek Lake would be the adverse aesthetic impacts associated with loss of the lake viewscape and the replacement with a view of the lake bottom area devoid of vegetation. These activities would continue to be adversely affected until such time as the dam could be restored and the lake returned to the multipurpose pool elevation.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would involve permanent drawdown of the pool to elevation 1,050 ft., m.s.l. This activity in itself would not

4492 directly affect any picnic facilities at Tuttle Creek Lake. Probably the greatest effect
4493 this change in operation would have comes from the adverse aesthetics associated
4494 with the lowered pool. This may cause picnickers to use alternate sites at other
4495 lakes/parks or the facilities downstream of Tuttle Creek Dam. Outside of this
4496 possible increased use, picnic facilities and picnickers in River Pond State Park and
4497 the Outlet area would not be affected by the Restricted Lake Operation alternative.
4498

4499 Under this alternative there is still the remote possibility of a major seismic
4500 event that would cause severe damage to the dam and result in the uncontrolled
4501 release of the Tuttle Creek pool. Should this occur, picnicking facilities and areas
4502 would be most severely affected at River Pond State Park and Outlet Park. These
4503 adverse effects would be fairly short term until facilities and services in the area
4504 could be restored. The main adverse effect to picnicking on areas upstream and
4505 adjacent to Tuttle Creek Lake would be the adverse aesthetic impacts associated
4506 with loss of the lake viewscape and the replacement with a view of the lake bottom
4507 area devoid of vegetation. These activities would continue be adversely affected
4508 until such time as the dam could be restored and the lake returned to the
4509 multipurpose pool elevation.
4510

4511 **Stabilize Foundation Soil with Drawdown (C.2 in FEvR)**

4512

4513 The Stabilize Foundation Soil with Drawdown alternative would involve the
4514 same adverse aesthetic impacts associated with a lake drawdown as are described
4515 for the Restricted Lake Operation alternative. These effects, although not a
4516 permanent change, would be fairly long term considering the 7-10 year construction
4517 period.
4518

4519 In addition, the construction activity on the dam would directly affect picnic
4520 facilities in River Pond State Park. As mitigation for any picnic facilities directly
4521 affected by the construction activity, the Corps would reconstruct the facilities at
4522 another area in River Pond State Park or within upstream areas leased by KDWP
4523 based on coordination with KDWP.
4524

4525 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

4526

4527 The effects of a lake drawdown on picnickers using facilities adjacent to
4528 Tuttle Creek Lake upstream of the dam would be avoided under the Stabilize
4529 Foundation Soil without Drawdown alternative.
4530

4531 Effects and proposed mitigation for direct construction related impacts on
4532 facilities/users of areas in River Pond State Park would be the same as those
4533 described for the Stabilize Foundation Soil with Drawdown alternative.
4534

4535 **Enlarge Embankment (C.3 in FEvR)**

4536

4537 Effects to picnic facilities and users would be the same as for the Stabilize
4538 Foundation Soil with Drawdown alternative. The main difference being that the
4539 large berm on the downstream side of the dam would permanently displace some

areas available for use in River Pond State Park. As mitigation for any picnic facilities directly affected by the construction activity, the Corps would reconstruct the facilities at another area in River Pond State Park or within upstream areas leased by KDWP based on coordination with KDWP.

4.3.7.7 Tuttle Creek ORV Area/Spillway Cycle Area

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would involve no construction activity and no change in project operations, therefore no impacts to the Tuttle Creek ORV Area or Spillway Cycle Area would be expected.

Even if a major seismic event caused severe damage to the dam and resulted in the uncontrolled release of the Tuttle Creek pool, use of these recreation facilities would not be affected.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would result in no adverse effects to either the Tuttle Creek ORV Area or the Spillway Cycle Area. These facilities would both remain fully functional. Permanent drawdown of the lake would require the placement of additional vehicle barricades to prevent vehicle access to the lakebed from established trails in the Tuttle Creek ORV Area.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The effects of Stabilize Foundation Soil with Drawdown would be the same as the effects listed for Restricted Lake Operation for the 7-10 year construction period. Temporary drawdown of the lake would require the placement of additional vehicle barricades to prevent vehicle access to the lakebed from established trails in the Tuttle Creek ORV Area.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

Stabilize the Foundation Soil without Drawdown would have no adverse effects on the Tuttle Creek ORV Area or the Spillway Cycle Area.

Enlarge Embankment (C.3 in FEvR)

The effects of Enlarge Embankment would be the same as the effects listed for Restricted Lake Operation for the 7-10 year construction period. Temporary drawdown of the lake would require the placement of additional vehicle barricades to prevent vehicle access to the lakebed from established trails in the Tuttle Creek ORV Area.

4.3.7.8 Radio-Controlled Flying Field

“No Action” Alternative (A. in FEvR)

There would be no effects on the radio-controlled flying field under this alternative.

Restricted Lake Operation (B.4 in FEvR)

There would be no effects on the radio-controlled flying field under this alternative.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The existing road on the downstream left abutment would be used as a construction access road under this alternative.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

Effects would be the same as those identified under Stabilize Foundation Soil with Drawdown.

Enlarge Embankment (C.3 in FEvR)

Effects would be the same as those identified under Stabilize Foundation Soil with Drawdown.

4.3.7.9 Special Events

“No Action” Alternative (A. in FEvR)

The “No Action” Alternative would have no effect on special events held at Tuttle Creek Lake. There would be no construction or changes in operation.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, downstream areas in River Pond State Park, where the Country Stampede is held, would be adversely affected until the area could be restored.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would have no effect on any of the identified special events at Tuttle Creek Lake. The lowered lake level could adversely affect other boating and fishing related organized events that are held at Tuttle Creek Lake.

Under this alternative there is still the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, downstream areas in River Pond State Park, where the Country Stampede is held, would be adversely affected until the area could be restored.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

The proposed contractor work area for the Stabilize Foundation Soil with Drawdown alternative would directly affect the area within River Pond State Park that has been used for the annual Country Stampede.

The area used for the annual Country Stampede will be directly and significantly impacted by construction. However, the Corps of Engineers will work closely with the construction contractor and event coordinators to ensure that the area remains available for the event. This could be accomplished by adjusting equipment staging, work sequencing, or other methods to avoid impacts during the time leading up to and during the event.

The lowered lake level could adversely affect other boating and fishing related organized events that are held at Tuttle Creek Lake.

Upon completion of construction activity, there would be no effects on special events, even after a major seismic event.

The road leading from the east end of the dam, past the radio-controlled flying field and to the downstream side of the dam would be closed to the public at Highway 13 and would be used for construction traffic only. Access to the radio-controlled flying field would be maintained through the downstream River Pond road network.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize Foundation Soil without Drawdown would have the same effects and proposed mitigation for the Country Stampede as the Stabilize Foundation Soil with Drawdown alternate. Since there would be no drawdown of the lake, other boating and fishing related organized events that are held at Tuttle Creek Lake would not be affected.

Upon completion of construction activity, there would be no effects on special events, even after a major seismic event.

Enlarge Embankment (C.3 in FEvR)

The Enlarge Embankment alternative would have long-term adverse effects to the Country Stampede as much of the area utilized for this event would be utilized for construction of the large berm on the downstream side of the dam.

Relocation of the event to another area at River Pond State Park or at another nearby facility would be the only options to mitigate the permanent effects of the proposed construction.

4.3.7.10 Recreation Related Businesses

“No Action” Alternative (A. in FEvR)

Under the “No Action” alternative there would be no effects on recreation related businesses. There would be no construction or changes in operation.

Under this alternative there is the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, recreation related businesses at the lake and in the project area would be adversely affected until the dam/lake and any damaged recreation facilities could be restored.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation alternative would probably have the greatest affect on boating and fishing related businesses at the lake and in the Manhattan area. The lake would be operated at a multipurpose pool elevation of 1,050 ft., m.s.l., resulting in a smaller lake at normal pool. This would be a permanent change in operation and a long-term effect. Continuing to operate the pool for flood control would result in a greater amount of fluctuation in lake elevation than what is currently experienced under the “No Action” alternative. The existing marina in Spillway State Park would have to be permanently relocated to an area where it would be serviceable at the elevation 1,050 ft., m.s.l. The existing marina in Spillway State Park may require modification to ensure that it would be capable of operating with the greater lake fluctuation. Relocation of the marina could expose it to more wind and wave action, which could require the construction of breakwaters. Lowering the lake level and increased fluctuation in the lake levels could adversely affect fish populations, which could result in less use by fishermen. Marsh areas at the upper end of the lake could be affected by the proposed lower multi-purpose pool elevation. These areas provide important wetland habitat for game and non-game species and recreational opportunities for hunters and wildlife viewing, which would be reduced. The lowered lake may be less aesthetically pleasing to recreational users. The combination of these factors may result in long-term reduced visitation for Tuttle Creek Lake as recreational users choose alternate destinations. This overall reduced use would affect recreation related businesses at the lake and in the project area.

The Restricted Lake Operation alternative would have no adverse effect on the Kansas River Outfitters, located in River Pond State Park. Kansas River Outfitters operates under a sub-lease agreement with the Kansas Department of Wildlife and Parks.

Under this alternative there is still the remote possibility of a major seismic event that would cause severe damage to the dam and result in the uncontrolled release of the Tuttle Creek pool. Should this occur, recreation related businesses at the lake and in the project area would be adversely affected until the dam/lake and any damaged recreation facilities could be restored.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

Lowering of the pool to elevation 1,050 ft., m.s.l. for the 7-10 year construction period would result in the same effects as described for the Restricted Lake Operation alternative. Although not a permanent change in operation, the 7-10 year construction period represents a fairly long-term temporary impact that would have serious adverse effects on recreation related businesses.

Use of the existing road on the left downstream abutment as a construction access road will reduce, but not prevent, access to the Kansas River Outfitters facility at River Pond State Park. While day users of River Pond State Park will be affected less by the construction activity, campers may choose alternate camping areas. Any reduced visitation at River Pond State Park would probably result in a corresponding reduction in business for Kansas River Outfitters.

Long-term after construction, Tuttle Creek dam would be expected to survive a major seismic event and continue to support existing level of recreation and related business.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

The Stabilize Foundation Soils without Drawdown alternative avoids impacts to recreation related businesses associated with a 7-10 year construction drawdown of Tuttle Creek Lake. Effects on Kansas River Outfitters would be the same as Stabilize Foundation Soil with Drawdown and Enlarge Embankment alternatives.

Enlarge Embankment (C.3 in FEvR)

Effects on recreation related businesses would be the same as for the Stabilize Foundation Soil with Drawdown Alternative. The exception being that if construction of the large berm on the downstream side of the dam resulted in the Country Stampede being relocated to an area outside of River Pond State Park, Kansas River Outfitters would see a reduction in related business before and after this event.

4.3.8 Archaeological & Historic Resources

“No Action” Alternative (A. in FEvR)

The fee lands at Tuttle Creek Lake contain 133 archeological sites and seven historic former townsites. Twenty-eight archeological sites and three historic townsites are below the multipurpose pool elevation of 1,075 ft. m.s.l. Cultural

resources sites north of the State Route 16 (Randolph) bridge are covered with substantial amounts of sediment. Within the area that would be inundated by the uncontrolled release of the Tuttle Creek pool there are currently 20 known archaeological sites and 11 Government Land Office recorded historic sites listed on the state inventory. Much of the inundated area has not been surveyed and it would be expected that there are additional subsurface archaeological sites and standing historic structures in this area. The "No Action" Alternative would have no adverse effects on these known historic properties. Management of cultural resources at Tuttle Creek Lake would continue in accordance with the KCD's existing Historic Properties Management Plan. Management of cultural resources off Corps fee ground would continue in accordance with applicable Federal and state regulations. As such, the "No Action" Alternative would have no effect on any known historic properties or cultural resource sites located on Corps fee ground or areas downstream of Tuttle Creek Lake.

There is the extremely remote possibility, under the "No Action" Alternative, that Tuttle Creek Lake would experience a seismic related dam failure. Should that occur, cultural resources on Corps fee ground and areas downstream of Tuttle Creek Lake could be adversely affected. Historic properties located upstream of the dam that are currently below multipurpose pool and not covered with sediment would be exposed to potential vandalism and looting until such time as the dam was restored and lake returned to the multipurpose pool elevation. Historic properties, especially standing structures, in the inundated area downstream could be damaged by the uncontrolled release of the pool. In addition, scouring flows associated with an uncontrolled release could expose subsurface archaeological sites on the downstream floodplain, making them more susceptible to looting or vandalism.

Restricted Lake Operation (B.4 in FEvR)

There are 22 archeological sites and three historic townsites south of the bridge within the multipurpose pool between elevations 1,075-1,050 ft. m.s.l. Of the 22 sites, 15 archeological sites and the three townsites are buried under sediment ranging from 3 to 10 ft. and would not be affected by permanent drawdown of the lake unless aeolian erosion exposes cultural materials. Seven prehistoric sites (14PO19, 14PO604, 14RY16, 14RY17, 14RY27, 14RY335, and 14RY368) that extend from elevations higher than 1075 ft. m.s.l. to below pool elevations ranging from 1050-1070 ft. m.s.l. could be affected by lowering the pool.

The conditions of these seven sites are unknown. Three sites (14PO19, 14RY16, and 14RY335) were recommended for no further work by past archeological investigations and are considered ineligible for the National Register of Historic Places. Four sites (14PO604, 14RY17, 14RY27, and 14RY368) are potentially eligible. Although only four sites have the potential to contribute new data to the regional archeological database, all seven sites could contain artifacts beneficial to the historic record.

Portions of sites in shallow water near the shoreline could have been destroyed by erosional wave action. However, drawdown could result in the exposure of cultural materials redistributed by wave action. Exposure of sites to visitors could increase vandalism from digging or unauthorized collecting of artifacts. Monitoring of the seven sites would determine site conditions in areas that were inundated, the presence of artifacts, and any occurrences of vandalism.

It is too premature to know if drawdown could have any adverse effect on the 22 sites located below the pool. Eighteen of these sites are buried and four could be affected by erosion.

Fifteen archeological sites and three historic townsites, located between elevations 1,075-1,050 ft. m.s.l., are buried under sediment ranging from 3 to 10 feet. These sites are currently protected because they are buried by at least three feet of silt. Consequently, there would be no effect to these sites as long as they remain capped by the sedimentation. Periodic monitoring would be performed to observe ground conditions and verify that sites or their artifacts are not exposed.

Four sites (14PO604, 14RY17, 14RY27, and 14RY368) located along the shoreline could be affected by drawdown of the lake. These sites extend from elevations higher than 1,075 ft. m.s.l. to below pool elevations ranging from 1,050-1,070 ft. m.s.l. and lowering the pool could cause erosion and potentially expose artifacts and/or features. These four sites would be monitored at set intervals to identify any effects that could occur.

If any changes would be noted as a result of drawdown, the US Army Corps of Engineers would consult with the Kansas State Historic Preservation Officer (SHPO) about the monitoring findings. The Corps and the SHPO would then determine an appropriate course of action. Additional information concerning these sites is included in Appendix H – Cultural Resource Sites at Tuttle Creek Lake.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

Stabilization of the foundation soil would only occur within the dam structure where no sites are located. Stabilization of the foundation soil and berm construction would have no effect on historic properties or other cultural resources.

Borrow locations to obtain material for supplementing the existing soil in rebuilding the berms have not been identified. When borrow areas are proposed, they will be reviewed to determine if any known historic properties are present and surveyed to determine if unknown historic properties are present if the proposed locations had not been previously surveyed or borrowed from. If historic properties are present, evaluation of these properties and appropriate coordination with the State Historic Preservation Office will occur prior to any borrow activity.

Drawdown of the lake associated with this alternative could have an effect on sites. There are 22 archeological sites and three historic townsites south of the bridge within the multipurpose pool between elevations 1,075-1,050 ft. m.s.l. Of the

22 sites, 15 archeological sites and the three townsites are buried under sediment ranging from 3 to 10 ft. and would not be affected by temporary drawdown of the lake. Seven prehistoric sites (14PO19, 14PO604, 14RY16, 14RY17, 14RY27, 14RY335, and 14RY368) that extend from elevations higher than 1075 ft. m.s.l. to below pool elevations ranging from 1,050-1,070 ft. m.s.l. could be affected by lowering the pool.

The conditions of these seven sites are unknown. Three sites (14PO19, 14RY16, and 14RY335) were recommended for no further work by past archeological investigations and are considered ineligible for the National Register of Historic Places. Four sites (14PO604, 14RY17, 14RY27, and 14RY368) are potentially eligible. Although only four sites have the potential to contribute new data to the regional archeological database, all seven sites could contain artifacts beneficial to the historic record.

Portions of sites in shallow water near the shoreline could have been destroyed by erosional wave action. However, drawdown could result in the exposure of cultural materials redistributed by wave action. Exposure of sites to visitors could increase vandalism from digging or unauthorized collecting of artifacts. Monitoring of the seven sites would determine site conditions in areas that were inundated, the presence of artifacts, and any occurrences of vandalism.

It is too premature to know if drawdown could have any adverse effect on the 22 sites located below the pool. Eighteen of these sites are buried and four could be affected by erosion.

Fifteen archeological sites and three historic townsites, located between elevations 1,075-1,050 ft. m.s.l., are buried under sediment ranging from 3 to 10 feet. These sites are currently protected because they are buried by at least three feet of silt. Consequently, there would be no effect to these sites as long as they remain capped by the sedimentation. Periodic monitoring would be performed to observe ground conditions and verify that sites or their artifacts are not exposed.

Four sites (14PO604, 14RY17, 14RY27, and 14RY368) located along the shoreline could be affected by drawdown of the lake. These sites extend from elevations higher than 1,075 ft. m.s.l. to below pool elevations ranging from 1,050-1,070 ft. m.s.l. and lowering the pool could cause erosion and potentially expose artifacts and/or features. These four sites would be monitored at set intervals to identify any effects that could occur. Additional information concerning these sites is included in Appendix H – Cultural Resource Sites at Tuttle Creek Lake.

If any changes would be noted as a result of drawdown, the US Army Corps of Engineers would consult with the Kansas State Historic Preservation Officer (SHPO) about the monitoring findings. The Corps and the SHPO would then determine an appropriate course of action.

4922 **Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)**

4923
4924 Stabilization of the foundation soil would only occur within the dam structure
4925 where no sites are located. Stabilization of the foundation soil and berm
4926 construction would have no effect on historic properties or other cultural resources.
4927

4928 Borrow locations to obtain material for supplementing the existing soil in
4929 rebuilding the berms have not been identified. When borrow areas are proposed,
4930 they will be reviewed to determine if any known historic properties are present and
4931 surveyed to determine if unknown historic properties are present if the proposed
4932 locations had not been previously surveyed or borrowed from. If historic properties
4933 are present, evaluation of these properties and appropriate coordination with the
4934 State Historic Preservation Office will occur prior to any borrow activity.
4935

4936 This alternative avoids potential effects to cultural resource sites that are
4937 located below the multi-purpose pool elevation and could potentially be affected by
4938 a lake drawdown.
4939

4940 **Enlarge Embankment (C.3 in FEvR)**

4941
4942 No sites are located in either the proposed upstream or downstream berm
4943 construction areas. Berm construction would have no effect on historic properties
4944 or other cultural resources.
4945

4946 Dredging locations to obtain material for building the berms have not been
4947 identified. Dredging could occur in the lake upstream or downstream. There are
4948 no sites located in this disturbed downstream lake area (River Pond) that was used
4949 as a borrow site during dam construction. In the upstream lake area, there are
4950 inundated archeological sites and the historic townsites of Stockdale, Randolph,
4951 and Garrison that were razed for Tuttle Creek Lake construction. The historic
4952 townsites have foundations, steps, and other architectural remnants buried under
4953 4-10 feet of sediment. Dredging activities would be coordinated to avoid all site
4954 locations. Avoidance would eliminate the possibility of any site disturbances.
4955

4956 Drawdown of the lake associated with this alternative could have an effect on
4957 sites. There are 22 archeological sites and the three historic townsites south of the
4958 bridge within the multipurpose pool between elevations 1,075-1,050 ft. m.s.l. Of the
4959 22 sites, 15 archeological sites and three townsites are buried under sediment
4960 ranging from 3 to 10 ft. and would not be affected by temporary drawdown of the
4961 lake. Seven prehistoric sites (14PO19, 14PO604, 14RY16, 14RY17, 14RY27,
4962 14RY335, and 14RY368) that extend from elevations higher than 1075 ft. m.s.l. to
4963 Below pool elevations ranging from 1,050-1,070 ft., m.s.l. could be affected by
4964 lowering the pool. Additional information concerning these sites is included in
4965 Appendix H – Cultural Resource Sites at Tuttle Creek Lake.
4966

4967 The conditions of these seven sites are unknown. Three sites (14PO19,
4968 14RY16, and 14RY335) were recommended for no further work by past
4969 archeological investigations and are considered ineligible for the National Register

of Historic Places. Four sites (14PO604, 14RY17, 14RY27, and 14RY368) are potentially eligible. Although only four sites have the potential to contribute new data to the regional archeological database, all seven sites could contain artifacts beneficial to the historic record.

Portions of sites in shallow water near the shoreline could have been destroyed by erosional wave action. However, drawdown could result in the exposure of cultural materials redistributed by wave action. Exposure of sites to visitors could increase vandalism from digging or unauthorized collecting of artifacts. Monitoring of the seven sites would determine site conditions in areas that were inundated, the presence of artifacts, and any occurrences of vandalism.

It is too premature to know if drawdown could have any adverse effect on the 22 sites located below the pool. Eighteen of these sites are buried and four could be affected by erosion.

Fifteen archeological sites and three historic townsites, located between elevations 1,075-1,050 ft. m.s.l., are buried under sediment ranging from 3 to 10 feet. These sites are currently protected because they are buried by at least three feet of silt. Consequently, there would be no effect to these sites as long as they remain capped by the sedimentation. Periodic monitoring would be performed to observe ground conditions and verify that sites or their artifacts are not exposed.

Four sites (14PO604, 14RY17, 14RY27, and 14RY368) located along the shoreline could be affected by drawdown of the lake. These sites extend from elevations higher than 1,075 ft. m.s.l. to below pool elevations ranging from 1,050-1,070 ft. m.s.l. and lowering the pool could cause erosion and potentially expose artifacts and/or features. These four sites would be monitored at set intervals to identify any effects that could occur.

If any changes would be noted as a result of drawdown, the US Army Corps of Engineers would consult with the Kansas State Historic Preservation Officer (SHPO) about the monitoring findings. The Corps and the SHPO would then determine an appropriate course of action.

4.3.9 Environmental Justice

“No Action” Alternative (A. in FEvR)

The “No Action” alternative would continue the study area’s exposure to the threat of a seismic related dam failure and uncontrolled release of the Tuttle Creek pool. In the study area, as in many other places, the poorest residents live in the flood plain, while the more affluent residents live in elevated areas. Those who live in the potentially inundated area on the flood plain stand to lose everything if a major seismic event results in dam failure and uncontrolled release of the Tuttle Creek pool. If that were to occur, homes, businesses, and farmlands would be completely submerged for 3 days. High velocity flows could rip buildings from their foundations, carrying them off or severely damaging them. There would be

extensive property damage associated with the loss of personal belongings and business equipment, silt deposition, and water damage. In addition, there would be the potential for the loss of human life.

In addition, businesses and farms in the potentially inundated area provide many jobs for residents who live in the area, and many of the jobs are low to middle-income warehouse, factory, retail and farm related jobs. A seismic related failure of the Tuttle Creek Dam and uncontrolled release of the pool would cause business interruptions that would jeopardize workers' wages and salaries and cause major problems in particular for those living from paycheck to paycheck. Social services often face financial crunches in the year following a major disaster, due to the temporary reductions in the tax base that result from business losses and interruptions. Because of the low probability of a major seismic event occurring in the project area, property values may not be affected and potential businesses may not consider the potential threat of a seismic related dam failure a factor when considering a location in the potential inundation area.

Restricted Lake Operation (B.4 in FEvR)

The Restricted Lake Operation Alternative would expose those individuals and businesses in the potentially inundated area on the Kansas River floodplain to lower risk than the "No Action" alternative. As noted above, in the study area, as in many other places, the poorest residents live in the flood plain, while the more affluent residents live in elevated areas. Although lower, the potential for a seismic related dam failure, uncontrolled release of the Tuttle Creek pool and potential loss of human life and property damage would not be eliminated under this alternative. The 1,050 ft., m.s.l. elevation was identified as an elevation that should a major seismic event occur, downstream property damage and potential loss of human life would be minimal. Under this alternative, Tuttle Creek Lake would continue to be operated for flood control. Much of the time the pool elevation would be above elevation 1,050 ft., m.s.l. As the pool would increase above this elevation during operation for flood control, risks of potential loss of human life and property damage would increase. Depending on the elevation of the pool when a major seismic event occurred, minority and low income populations located in the potentially inundated area may be minimally affected or could be seriously affected at a level similar to the "No Action" alternative.

Because of the close proximity to the City of Manhattan, the public recreation areas at Tuttle Creek Lake provide important recreation opportunities to low income and minority populations in the project area. As described in this report, even the temporary lowering of the pool during construction would have serious adverse effects on the recreation users at Tuttle Creek Lake. These effects would become permanent under the Restricted Lake Operation alternative. In addition, since the dam would not withstand a major seismic event, should this occur, loss of the pool and major restoration of the dam would adversely affect the recreation experience at Tuttle Creek Lake for several years.

Stabilize Foundation Soil with Drawdown (C.2 in FEvR)

By implementing the Stabilize the Foundation Soil with Drawdown alternative the potential for loss of human life and property damage as a result of a seismic related dam failure and uncontrolled release of the Tuttle Creek pool would be eliminated. As noted above, in the study area, as in many other places, the poorest residents live in the flood plain, while the more affluent residents live in elevated areas. Because of the low risk associated with a major seismic event occurring in the project area, it is difficult to determine what, if any, effect taking "No Action" would have on property values in the potentially inundated area on the floodplain. Implementing the Stabilize Foundation Soil with Drawdown alternative would minimize these potential effects.

During the 7-10 year construction period, this alternative would have similar effects on recreation as the Restricted Lake Operation alternative. In addition, areas at River Pond State Park and Outlet Park would be affected by construction on the downstream side of the dam. As noted above, because of the close proximity to the City of Manhattan, the public recreation areas at Tuttle Creek Lake provide important recreation opportunities to low income and minority populations in the project area. After construction, dam would be expected to survive a major seismic event and after inspection and expected minor repairs, recreation would be able to continue unaffected.

Stabilize Foundation Soil without Drawdown (preferred, C.2 in FEvR)

Same as the effects described under Stabilize the Foundation Soil with Drawdown but avoids effects associated with a 7-10 year construction drawdown.

Enlarge Embankment (C.3 in FEvR)

Effects would be the same as under Stabilize the Foundation Soil with Drawdown.

4.4 Cumulative Impacts

The combined incremental affects of human activity are referred to as cumulative impacts. While these affects may be insignificant on their own, accumulated over time, and from various sources, they can result in serious degradation of the environment. The analysis must consider past, present and reasonably foreseeable actions in the project area. The analysis must include consideration of actions outside of the Corps, to include other State and Federal agencies. As required by NEPA the Corps has prepared the following assessment of cumulative impacts related to the alternatives being considered in this EIS.

Past Actions:

European settlement of the State of Kansas and the Kansas River watershed has dominated the last 200 years and man's affect on the environment has progressed in this region at an exponential rate as technology and human population has increased. The relatively low numbers of Native Americans originally in this region had comparatively little effect on the natural landscape. Since Europeans first arrived in what is now the State of Kansas, the human population has steadily increased, cattle have replaced the bison on the native prairies and extensive agricultural rowcrop production has replaced the native vegetation on much of the remaining areas, especially on the floodplains of the Kansas River and its tributaries. By controlling fire, man has allowed a steady expansion of trees into the traditional prairie areas of central Kansas and this new habitat has allowed the expansion of species more typical of the eastern Kansas woodlands. In addition, man has introduced several species of non-native wildlife into the project area along with large numbers of domestic animals. The development and widespread use of the internal combustion engine and electrification of the region resulted in a substantial increase in mans ability to affect change on the environment. As agriculture became more mechanized, the farms have become fewer and larger in acreage. In addition, chemical fertilizers, pesticides and herbicides have come into widespread use in agriculture within the last 50 years. Runoff from agricultural and urban areas has adversely affected surface water quality. Failure to implement soil conservation practices combined with drought resulted in the Dust Bowl, which greatly affected the project area in the early 1930s. Although the overall population in the project area has increased, many of the small original settlements have disappeared, while larger established towns and cities have expanded greatly. In these urban areas, manufacturing and service industries have developed to supply jobs for an expanding population not directly involved with agricultural production. During European settlement of the area, major cities in the project area, like Manhattan, Topeka, Lawrence, and Kansas City, were all located in close proximity to the Kansas River and much of their subsequent development and expansion has occurred on the floodplain. With the exception of seasonal flooding, the rich fertile soils of the Kansas River and tributary floodplains were ideally suited to agricultural development. As agricultural production and urban development on the floodplain increased, man investigated and implemented numerous measures that would protect these important economic assets. Channelization of streams and rivers, construction of levees, stabilization of banklines, draining and filling of wetlands on the floodplain and eventually the construction of the major flood control levees and reservoirs in the Kansas River basin has resulted in significant adverse cumulative affects on the ecosystem while minimizing the economic and social affects associated with major damages caused by out of bank flows on the Kansas River and its tributaries. In addition to flood control, these reservoirs provide substantial benefits associated with their other Congressionally authorized project purposes of water supply, water quality, fish and

wildlife, recreation, and navigation support. Comments regarding the importance of Tuttle Creek Lake for recreation, flood control, fish and wildlife, water quality and water supply to the Manhattan community and the State of Kansas were well documented in the scoping comments from members of the community and State and Federal agencies.

Present Actions:

The population continues to increase in almost all of the project area, especially within established urban areas. With this increase in population there is continuing development and expansion. Expansion of these urban areas and associated habitat loss probably represents the most serious threat to fish and wildlife resources in the project area. Urban areas continue to expand onto traditionally agricultural lands and on the floodplain. Within most of these areas, State or City participants in the Federal Emergency Agency's National Flood Insurance Program currently regulate development on the floodplain. Although minimizing development within the mapped 100-year flood plain, this program does not prevent development on the natural floodplain outside the 100-year floodplain boundary. The Flood of 1993 demonstrated that during extreme events there still remains the potential for out of bank flows and associated damages on the Kansas River. After the Flood of 1993, FEMA sponsored buyouts of properties that were highly susceptible to flooding on the Kansas River floodplain. The Natural Resources Conservation Service working with farmers in the basin have implemented soil and water conservation practices on much of the agricultural land in the basin. While these practices have minimized the adverse affects from chemical pesticides, herbicides, and fertilizer in agricultural production, they continue to contribute to decreased surface water quality. Other measures that have provided improved water quality, fish and wildlife, and recreation benefits are the recently initiated State or Federal programs that provide financial incentives to protect riparian corridors, wetlands, and highly erodible land in the project area. With the exception of the Flood of 1993, out of bank flows are now extremely rare on the Kansas River. Water quality of the Kansas River, although fairly impaired, is assisted by increased detention time in and releases from the Corps reservoirs. These releases are very important during critical low flow periods. State administered programs ensure that discharges into the Waters of the United States are in compliance with water quality standards and that proposed construction activities include management practices that minimize and/or avoid adverse affects of site runoff on adjacent waterbodies. In addition, a State administered program regulates the withdrawal of surface and ground water, obstructions in streams and water diversions. Corps reservoirs in the basin are operated for flood control, recreation, fish and wildlife, water quality, water supply, and navigation support. As the population has increased greater importance has been given to the Corps reservoirs ability to support flood control, recreation, water supply, water quality, and fish and wildlife in the project area. Overall these reservoirs contribute greatly to the quality of human life in the project area. As reservoirs in the basin age, sediment accumulates in these basins. At this time, sedimentation is evident at some Corps lakes in the Kansas River basin and has affected some recreational facilities. Outside of recreation, other authorized project purposes have not been

substantially affected by sedimentation at this time. Development around Corps lakes has increased as new residences are constructed close to recreation opportunities. The Corps has identified deficiencies in the ability of Tuttle Creek Dam to withstand a major seismic event. This study evaluates three construction, one change in project operations and the "No Action" alternative to address this concern. The Corps proposes to implement the preferred alternative, Stabilize Foundation Soil without Drawdown. In addition, the Corps has completed a preliminary study of seismic adequacy for Milford Lake. Initial assessment of Milford Lake indicates that the dam would perform satisfactorily during a major seismic event. Corps will review the Milford assessment using latest technology. In addition, the Corps is currently undertaking studies of the existing levee system at Topeka and Kansas City. Corps administers numerous Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act regulated activities on the Kansas River, adjacent wetlands and tributaries. These include applications for channelization of streams and rivers, construction of levees, stabilization of banklines, draining and filling of wetlands on the floodplain. In addition the Corps is preparing to review the existing sand dredging permits on the Kansas River.

Reasonably Foreseeable Future Actions:

The three construction alternatives and even the "No action" alternative, considered in this EIS generally maintain the existing conditions at Tuttle Creek Lake and in the Corps' Kansas River lake system. Under each of these alternatives Tuttle Creek Lake would continue provide all of the existing level of benefits and support the existing Congressionally authorized project purposes. Only under the "Restricted Lake Operation alternative would the Congressionally authorized project purposes be substantially affected long term. The probability of a major seismic event occurring in the project area is fairly low. Implementation of the Restricted Lake Operation alternative would have serious adverse long-term affects on water supply, water quality, recreation, and fish and wildlife benefits associated with Tuttle Creek Lake. Changes in operation at Tuttle Creek Lake could affect operation of other Corps lakes in the basin and resources associated with the Kansas River. Changes in operation at other Corps lake would have substantial adverse affects on environmental resources. These major changes in operation would require evaluation and community input through the NEPA process.

Human population in the project area is expected to continue increasing in the foreseeable future. Increasing population will continue to result in development and expansion of the existing urban areas, including areas on the floodplain. Current regulations concerning floodplain development, water quality, water diversion, water withdrawal, and placement of fill material in the waters of the United States will play an ever more important role in minimizing adverse environmental affects associated with man's activities. With community support, State and Federal conservation incentive programs will continue to expand and include greater area. Soil and water conservation practices will incorporate new technologies to maintain or increase productivity and minimize adverse environmental affects of agricultural production activities. As the population in the project area increases, the importance of the Corps' reservoirs ability to support flood control, recreation, water supply,

water quality, and fish and wildlife in the project area will increase. Especially in the critical areas of water supply and water quality, the increasing human population will put increasing demands on surface waters that could have serious adverse cumulative affects on the aquatic ecosystem.

Area residents identified sedimentation of the reservoirs in the basin, and particularly at Tuttle Creek, as a major concern during initial project scoping. As reservoirs in the basin age and become filled with sediment, their ability to provide flood control, water supply, water quality and navigation support decrease to the point where they will no longer be capable of providing fulfilling all project purposes. Fish and wildlife, and recreation benefits would still be present, but would change substantially over time as sedimentation occurred.

Most of the Corps' lake projects were initially designed based on a 100-year economic life. The 100-year economic life is not the life expectancy of the dam or the lake, it is the assumed "payback" period when the project benefits offset the project construction costs. Unfortunately that term, used in the economic and engineering analyses of the project, has erroneously been interpreted by many to mean that 100 years after a project is built, there would be a lake completely filled with sediment. While many of these reservoirs may continue to provide benefits well beyond their "design" or "economic" life, one fact remains; eventually all will be filled with sediment if changes to project or lake level management is not made as the projects age.

Before Tuttle Creek Dam was constructed, it was assumed that approximately 228,000 acre-feet (54 percent) of the water storage space below the normal lake level would be filled with sediment in the year 2012. This is an average annual sedimentation rate of 4,560 acre-feet per year. Sediment surveys performed in 2000 showed that approximately 216,000 acre-feet of sedimentation had occurred. Over the 38 year life of the project at the time of that survey, the average annual sedimentation rate was 5,640 acre-feet per year. This rate is approximately 24 percent higher than originally predicted. If the average annual sedimentation rate for the past two years is added to the 2000 sediment survey volume, the current total sedimentation is at essentially the volume that was originally predicted to occur by 2012.

	1962 in Multipurpose Pool	2000 in Multipurpose Pool	1962 in Flood Pool	2000 in Flood Pool
Total Storage (Acre-Feet)	425,312	280,137	2,367,017	2,150,872
Total Sedimentation (Acre-Feet)	N/A	145,175	N/A	70,970
Projected Annual Sedimentation (Acre-Feet per year)	4,560	N/A	N/A	N/A
Actual Annual Sedimentation (Acre-Feet per year)	N/A	5,637	N/A	N/A

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The original sediment predictions also assumed that sedimentation would all occur below the normal lake level. As can be witnessed in the upper ends of the lake, due to the nature of the sediments and the flow conditions, sedimentation is occurring above the normal lake level during periods of high lake levels. The current sediment pattern is that 52 percent of the sediment is below the normal water level and 48 percent is above the normal lake level

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If the worst case is applied and it is assumed that none of the future sedimentation occurs above the normal lake level, the existing lake would be filled with sediment to the normal lake level in 50 years or the year 2052. If the current rates and distribution of sediments are applied, the lake would be expected to be filled with sediment to the current normal lake level in 96 years or the year 2098. The actual time at which the existing lake will not exist due to sedimentation is difficult to predict but is most likely somewhere between 50 and 100 years.

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It should be recognized that a lake of some limited size will most likely always remain in the immediate area of Tuttle Creek dam. Due to the velocity of the water flowing through the tower and outlet works, there will be an area in which sedimentation is limited and open water will most likely exist. It should also be realized that even though only a very small lake may exist at what is now the normal lake level, most of the storage in the flood storage above that level remains entirely effective and available for the flood control. After siltation to the normal lake level, the project could then function essentially as a dry dam and could still store large quantities of water during flood periods.

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Once the lake fills with silt to the normal lake level, the rate of sedimentation is expected to drop significantly since the water temporarily stored during floods would not have sufficient time or the appropriate flow conditions to allow the sediments to deposit as they do today. The sediment that flows into the lake would tend to flow with the water through the dam. Therefore, the dam could provide flood control benefits for many decades after the current normal lake level is completely silted in. By example, even if it is assumed that the current rate of sedimentation

continues forever, in addition to the 50 to 100 years that it would take for the regular lake level to fill with silt it would take an additional 380 years for the available space between the normal lake level and the top of the dam to completely fill with silt.

As the population in the region increases, development on the floodplain is likely to increase, and the need for flood control, water supply and water quality all increase accordingly. Therefore, as conditions demand, it is likely that the Corps of Engineers would consider options to continue to fulfill these project purposes from Tuttle Creek lake. The Corps of Engineers does not currently have regulations or guidance that addresses the operation or modification of lake projects as they experience siltation to the normal lake levels. Any evaluation of potential options to modify the project physically or change the operations would be evaluated through National Environmental Policy Act procedures using the appropriate engineering, economic, socio-economic, and environmental analyses. Potential future options to maintain the effectiveness of the existing reservoirs in the basin, including Tuttle Creek could include: removal of the accumulated sediment, raising the height of the existing dams, construction of new dams, reallocation and modifications to lake level management, implementation of measures in the basin that would prolong the useful life of the dams or provide alternate methods to achieve the existing project benefits, or a combination of any or all of the above alternatives. Many of these potential actions could result in very significant adverse environmental affects. Through the NEPA process, a thorough evaluation of the potential measure or measures would allow selection of an alternative that considers all of the economic, socioeconomic, environmental, and engineering considerations that exist at that time. That evaluation cannot currently reasonably be performed since the conditions in the region and the technology available 50 years in the future cannot be predicted.

Most adverse environmental affects have occurred as Past Actions. Currently as human population continues to expand in the project area, attempts are made to minimize and or avoid the adverse affects human actions have on the environment. In addition, actions to restore or enhance the ecosystem are undertaken in the project area. Since construction of Tuttle Creek Lake and other reservoirs in the Kansas River basin, resources have adjusted to the changed habitat and hydrology. A relatively stable period has occurred since construction of Tuttle Creek Lake and the other reservoirs in the Kansas River basin. Future effects are primarily associated with increased human population in the project area and increased demand on the limited resources provided by the existing system. Future effects on water quality, water supply, flood control, fish and wildlife resources, sedimentation of the reservoirs and increased recreational use of the lakes were identified as primary areas of concern. Of these, ongoing sedimentation of the reservoirs will affect each of these resources in the future and has the potential to result in the greatest adverse cumulative affect. The recommended action, Stabilize the Foundation Soil without Drawdown will avoid or minimize potential adverse cumulative affects on water supply, water quality, flood control, fish and wildlife resources, and recreational use of Tuttle Creek Lake and other lakes in the Corps' Kansas River system. The preferred alternative will not reduce or increase the affects of sedimentation at Tuttle Creek Lake or other lakes in the

basin. Although providing some reduction in sedimentation, implementation of the Restricted Lake Operation alternative would have serious adverse long-term effects on water supply, water quality, recreation, and fish and wildlife benefits associated with Tuttle Creek Lake.

4.5 The Relationship Between Local Short-Term Uses Of Man's Environment And The Maintenance And Enhancement Of Long-Term Productivity

Short-term uses of the environment that would occur as a result of construction of the project would include effects on vegetation, wildlife, air quality, recreation, and water quality. Adverse effects on air quality and water quality would be minimized to the greatest extent practicable and would be limited to the construction phase of the project. The quality of air and water in the project area will return to pre-project levels after construction is completed. No adverse effects on air quality or water quality would occur after project construction is completed. No adverse effects on the long-term productivity of the environment associated with air quality or water quality would occur. Minor adverse effects on vegetation and fish and wildlife resources would occur. These effects would be minor, short-term and related to the construction activity. The long-term productivity of vegetation and fish and wildlife resources in the project area would not be adversely affected. Stabilization of the Foundation Soil without Drawdown will continue to maintain the long-term productivity, associated with the project purposes of flood control, water supply, fish and wildlife, water quality, water supply, and navigation support, for which Tuttle Creek Lake was Congressionally authorized. Implementing measures that ensure dam safety will ensure the long-term productivity of areas downstream of Tuttle Creek Lake, in Manhattan and areas on the Kansas River floodplain.

4.6 Any Irreversible and Irretrievable Commitments of Resources Which Would Be Involved In The Proposed Action Should It Be Implemented

Implementation of the Stabilize Foundation Soil without Drawdown alternative would involve the irreversible and irretrievable commitment of large amounts of natural resources and human effort to complete. Natural resources would include the large amount of petroleum products (diesel fuel/gasoline) necessary to operate mechanized equipment that will transport material to the site and run equipment that will be used to modify the work site and stabilize the foundation soil. In addition, the process used to stabilize the foundation soil would be considered irreversible and the large amount of material injected into the foundation would be considered irretrievable. Construction of the replacement campsites/recreation facilities at River Pond State Park and Tuttle Cove would also require the irretrievable commitment of construction materials and petroleum products. A large amount of human effort will be required to complete the final design, administer and construct the project. Once all construction activities have been completed, operation and maintenance resource requirements for the overall project would be very similar to the current conditions.

4.7 Summary of Mitigation for Preferred Alternative

Although Stabilize the Foundation Soil without Drawdown has been identified as the preferred alternative, in part, because of its limited impacts to the community and environment, it does have impacts. However, most of these impacts can be largely offset. The intention of the Corps of Engineers is to offset impacts before they occur, when possible, such that a similar level of services is available to the community before the impact occurs. Therefore, construction of replacement and new roads, camping sites and other facilities are planned before significant disruption of existing facilities begins. It should be noted that the timing of construction for other than dam safety is funding dependent. Should funding in the initial stages of the project be limited, those funds may be used solely to reduce the risk to the downstream community instead of construction of recreational facilities.

Any efforts to offset or mitigate impacts to the community and environment will follow five basic guidelines defined by Corps of Engineers Counsel:

1. The offset of impacts must provide a consistent level of service to the community at Tuttle Creek Lake and shall not be based on compensation of specific individuals, organizations, and/or businesses.
2. Direct or indirect monetary compensation for the loss of services and/or expected revenue generated is not allowable to any business, organization or individual. New temporary leases to offset impacts are not allowable.
3. All measures implemented to offset impacts must be applied at Tuttle Creek Lake. For example, funding of a project at Milford Lake to offset impacts at Tuttle Creek Lake is not allowable.
4. Existing impacted facilities can be relocated or replaced at Tuttle Creek Lake to offset the temporary loss of facilities and to provide the same level of service to the community. Any measure implemented to offset impacts cannot provide betterment during the construction period of the project. For example, if six group shelters are not usable during the construction period, no more than six group shelters can be provided at alternate locations during this same period.
5. Land leased from the government can be modified at government expense and/or the lessee's expense to provide the same level of service to the community. Any and all betterments that are incorporated in association with measures to offset impacts shall be at the expense of the lessee and cannot be paid by the government with Dam Safety funding.

5479 In accordance with these general guidelines, the following impact offsets or
5480 mitigation measures are proposed as part of the preferred alternative, Stabilize
5481 Foundation Soil without Drawdown. Most of these measures were determined in
5482 coordination with the Kansas Department of Wildlife and Parks and through
5483 consultation with the U.S. Fish and Wildlife Service.

5484
5485 Since there are no significant adverse impacts on the following resources, no
5486 mitigation measures are planned: Geology, Minerals, and Soil; Air Quality;
5487 Biological Environment; Terrestrial Ecosystem; Wildlife; Aquatic Ecosystem;
5488 Threatened and Endangered Species, Socio-Economic Environment; Public Safety;
5489 Navigation; Utilities/Water Supply; Flood Control; Hunting; Boating; Archaeological
5490 & Historical Resources; and Environmental Justice.

5491
5492 **Water Resources and Water Quality:** During and after construction, the
5493 existing water supply well for the State Park will most likely not be a reliable water
5494 source for the park. During construction, changes in pH and suspended solids may
5495 occur. After construction, sufficient quantities of extractable water are not likely to
5496 be available in the area of the well. This well will be abandoned and the existing
5497 and new State Park facilities will be connected to the rural water supply system that
5498 exists to the southeast along Dyer Road. Payment for water usage will be the
5499 responsibility of the State Park.

5500
5501 Monitoring, containment and treatment as necessary will be performed for
5502 runoff from treatment areas that may contain excess suspended solids or have a
5503 high pH. This work will be performed in accordance with a National Pollution
5504 Discharge Elimination System permit to be obtained through the Kansas
5505 Department of Health and the Environment. The specific criteria and locations for
5506 monitoring will be documented in the permit that will be obtained before the initiation
5507 of construction.

5508
5509 With the installation of a groundwater seepage cutoff wall beneath the dam,
5510 the quantity of water discharged from the downstream relief wells should decrease
5511 significantly. This remaining flow will most likely not be sufficient to support the
5512 existing trout fishery in the stream below the dam. Therefore, the opening between
5513 the River Pond and the pond to the south of the main River Pond will be closed off
5514 with pervious fill to create a kids fishing area that will seasonally be used as a trout
5515 pond. Water will be able to flow between the two areas but the passage of boats
5516 and fish will be prevented.

5517
5518 Decreased relief well flow may also result in some reduction in the size of the
5519 downstream wetland area toward the west end of the dam. If this reduction occurs,
5520 expansion and modification of the area to restore its original size or other suitable
5521 mitigation will be performed.

5522
5523 During placement of rockfill or other materials that may increase turbidity in
5524 the lake, turbidity curtains or other measures to control the spread of fine sediments
5525 in the water will be employed. These measures will only be used during active

5526 construction in the lake and will not remain in place for the duration of the
5527 construction.

5528
5529 **Noise:** Noise is the primary issue other than physical encroachment that will
5530 require the offset of impacts.

5531
5532 Residences on the perimeter of the lake for some distance upstream,
5533 adjacent to the spillway, and potentially residences downstream will be able to hear
5534 construction equipment on the dam. The degree to which construction will be
5535 audible in surrounding residences will be dependent upon the time of year, wind
5536 conditions, the location on the dam where work is being performed and the type of
5537 work being performed. The contractors will be required to maintain effective muffler
5538 systems on equipment and the highest noise producing activities will be restricted to
5539 daylight hours whenever possible.

5540
5541 **Transportation:** Although a significant impact to the roadways in the
5542 Manhattan/Riley County area is not anticipated from this action, roadway monitoring
5543 in the immediate vicinity of the project and coordination with Riley and Pottawatomie
5544 Counties and Kansas Department of Transportation will be performed. Where new
5545 entrances or upgrades are required on public rights-of-way, the proper realty rights
5546 and permits will be acquired from the respective public entity.

5547
5548 **Fishing:** With the installation of a groundwater seepage cutoff wall beneath
5549 the dam, the quantity of water discharged from the downstream relief wells should
5550 decrease significantly. This remaining flow will most likely not be sufficient to
5551 support the existing trout fishery in the stream below the dam. Therefore, the
5552 opening between the River Pond and the pond to the south of the main River Pond
5553 will be closed off with pervious fill to create a kids fishing area that will seasonally be
5554 used as a trout pond. Water will be able to flow between the two areas but the
5555 passage of boats and fish will be prevented.

5556
5557 **Swimming:** Impacts of turbidity and noise on the River Pond swimming
5558 beach will be minimized by limiting construction in River Pond to times outside the
5559 summer swimming season.

5560
5561 **Camping/Hiking/Day Use Shelters:** Campers, hikers and other day use
5562 visitors in River Pond State Park are expected to be impacted to some degree by
5563 construction noise. Although these parks will not be totally unusable, some
5564 displacement of park users will likely occur as they search for alternate areas to
5565 provide a more undisturbed recreation experience.

5566
5567 All of the area downstream of Tuttle Creek Dam is included in the River Pond
5568 State Park and has been designated by the Kansas Department of Wildlife and
5569 Parks as National Park Service Land & Water Conservation Fund 6(f) property. The
5570 Dam Safety Assurance Program project will be coordinated with the Kansas
5571 Department of Wildlife and Parks such that full compliance with Land and Water
5572 Conservation Fund regulations is maintained.

To offset noise impacts as well as physical conflicts with construction, replacement camping facilities will be constructed. A similar number of sites to those impacted by construction activities will be constructed or upgraded in River Pond State Park, south of the River Pond, and in the Tuttle Creek Cove area to offset the impact to campsites closest to the dam. The existing 34 sites on the peninsula extending south into the River Pond area will be rehabilitated to fully accommodate late model recreation vehicles. These sites are considered to be far enough from the work area that the impacts of the work will not be significant. The number of sites that will exist in the area after the rehabilitation is dependent upon the available space and exact design layout. However, it is anticipated that the final number of sites will be something less than 34. New header ditch crossings will be constructed to facilitate new traffic flow patterns resulting from these modifications.

The River Pond State Park will be expanded south of the River Pond with the construction of approximately 50 replacement sites. The sites will be a mix of full utility sites that will accommodate late model recreational vehicles as well as more limited sites to accommodate smaller vehicles. The exact configuration and mix of the sites is dependent upon the final design layout and space limitations. The area to be utilized includes the open area of a current K-State license and the wooded area immediately south of the southwest corner of the River Pond. A shower building and dump station will be constructed south of the River Pond to support these camp sites. The dump station will either connect to the existing lagoon or a new lagoon facility will be constructed. The area being proposed for campgrounds contains several large trees that could potentially be used as roost trees for bald eagles. No large roost trees will be removed or impacted. Additionally, the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service have agreed to close this campground in the winter to avoid potential impacts to bald eagles using the area.

Construction of a new campground with approximately 40 sites is proposed for the Tuttle Cove draw area to offset the loss of use of campsites below the dam. These facilities will be located above all but the most extreme pool level fluctuations. Due to the nature of the terrain and access to the area, these facilities will not be as attractive to late model recreational vehicle owners as the sites in River Pond State Park. The Tuttle Cove replacement facilities will include associated comfort station upgrades, toilet facilities, day use facilities, expanded boat ramp and general modifications associated with the replacement camping facilities. The replacement facilities will be constructed in compliance with the Americans with Disabilities Act.

The development of new or upgraded facilities in the Spillway State Park area is not proposed.

Tuttle Cove and the area downstream of the River Pond are considered to be close enough to the River Pond and Outlet Park areas that displaced visitors are likely to use the replacement facilities. These sites are far enough away from the construction area that the noise and construction impacts will be minimal or eliminated. Construction of replacement facilities is not considered practicable in

the other existing park areas of Tuttle Creek Lake, namely Carnahan, Stockdale, Fancy Creek, and Randolph Park areas due to the distance these parks are located from the River Pond and Outlet Parks.

The day use area occupied by Shelters 3 and 4 will be unusable during construction due to the extreme proximity to the construction area. Impacts to these two shelters will be offset by improving other park shelters in the area by replacing the shelters in their entirety and/or the lost amenities of these shelters. This may include construction of additional playgrounds, water, and toilet facilities in the Outlet Park, Spillway Park, and/or Tuttle Cove Park areas. It is likely that both Shelter 3 and 4 will be destroyed during construction and replacement at their existing location will be required upon construction completion.

The nature trail system below the dam will be impacted by the project. The trailhead of the nature trail in the old river channel will be inaccessible during construction and impacted the most. An alternate access point to this trail will be provided by extending the trail in the River Pond State Park across the old river channel by construction of a foot bridge to reach the area. In addition, a trail will be constructed at the Observation Point area to offset trail impacts below the dam. The existing Cedar Ridge Trail in Spillway Park will remain available.

Since significant heavy equipment traffic will exist on and adjacent to the dam, traffic patterns will be adjusted and new roads will be constructed to completely avoid camping and day use traffic conflicts with construction equipment. The area within a few hundred feet of the road downstream of the dam will be off-limits to the public (except for special events). The existing public access to the downstream side of the dam from the west will be maintained by connecting the toe road east of the tubes to the park road just east of the wetland area. Header ditch crossings will be constructed to accommodate the new traffic pattern as required. Both sides of the outlet area (tubes) and the day use area downstream of the stilling basin on the east side of the outlet works will remain open to the public. Day use activities including fishing and picnicking are conducted in this area. Impacts to these areas are considered to be minimal.

The road leading from the east end of the dam, past the radio-controlled flying field and to the downstream side of the dam will be closed to the public at Highway 13 and will be used for construction traffic only. Access to the radio-controlled flying field will be maintained through the downstream River Pond road network.

To provide access to the downstream area including the existing and new areas of River Pond State Park, a new River Pond park entrance with appropriate signage and an entrance station will be constructed leading north from Dyer Road at the southeast corner of the park. Details of the intersection of the new entrance road with Dyer Road will be evaluated to ensure traffic safety. The new entrance road will follow the former alignment of the county road in this area. This road will cross the spillway alignment and will be sacrificial (at the Corps of Engineers' cost) if a spillway discharge occurs. The Corps of Engineers will own and maintain this

road. A barrier will also be constructed along one side of this road to avoid conflicts with the Spillway Cycle area. Construction of new interior park roads and header ditch crossings will be necessary to connect all portions of the River Pond State Park to this new entrance. Existing park roads leading north to the dam will be blocked with pipe gates or by other means to allow emergency access but prevent conflicts with heavy equipment. These changes are anticipated to be permanent.

Informational kiosks explaining the dam safety construction program will be constructed at each end of the dam, the scenic overlook, and in the River Pond State Park to explain the construction.

Picnicking: Shelter houses and other day use facilities that are immediately adjacent to or impacted by construction will require replacement or new facilities will be required. Proposed new facilities are discussed in "Camping/Hiking" above. Replacement of existing facilities is discussed here. Specifically, the day use area and shelter immediately east of the stilling basin (the tubes) will be immediately adjacent to a construction staging area or destroyed by construction. These facilities will require replacement after construction is complete.

Radio-Controlled Flying Field: The area will remain at its current location. Access to the radio-controlled flying field will be modified but maintained through the downstream River Pond road network.

Special Events: The area used for the annual Country Stampede will be directly and significantly impacted by construction. However, the Corps of Engineers will work closely with the construction contractor and event coordinators to ensure that the area remains available for the event. This could be accomplished by adjusting equipment staging, work sequencing, or other methods to avoid impacts during the time leading up to and during the event. It is unlikely that the area will be maintained with grass cover during construction.

Recreation Related Business: The primary recreation related business that would be impacted by construction on the dam is the Kansas River Outfitters in the River Pond area. Noise would be the primary impact that would be expected to decrease camping and day use activities of the River Pond State Park. Day use of the River Pond area in the vicinity of the Kansas River Outfitters is not expected to decrease significantly during construction. Currently, only traffic in the day use area passes near the Kansas River Outfitters facility. With the rehabilitation and addition of new campsites in the River Pond area as well as modification of the traffic patterns and construction of a new park entrance, available business to Kansas River Outfitters may actually increase. It should be noted that the Kansas River Outfitters is located on the River Pond but, as its name implies and its web site indicates, its business is conducted on the Big Blue and Kansas Rivers as well. The proposed project is not expected to have any impact on those portions of the business conducted outside the River Pond State Park area.

The Big Dawg Marina is located in the Spillway Park area on the main body of the lake. The Spillway Park is not expected to be impacted by construction activities, so vehicular access to this area will not be disrupted. Impacts to water based recreation that utilize Tuttle Creek Lake is expected to be minimal, therefore, no significant impacts to Big Dawg Marina are expected to occur.

Kansas State University Rowing Lease: Kansas State University leases an area immediately upstream of the spillway inlet channel. This area is comprised of a club house, dock area, and other amenities that support the rowing sport. The land based portion of the lease is not expected to be impacted by the construction activities since that area is not within the construction area and the roads leading to the area are not impacted. However, the rowing team also maintains a buoyed rowing course along the length of the dam. Construction in this manner utilizes the dam as a wind break from southerly winds during the spring, summer, and fall rowing period. Little to no rowing is conducted in the winter. Since the upstream portion of the dam is proposed to be significantly impacted by construction activity, impacts to the rowing club are to be expected as a result of the project. A minimum safe distance will be determined upstream of the construction area and a new rowing course will be established.

5. Recommendation to Implement the Preferred Alternative – Stabilize Foundation Soil without Drawdown

The Corps has identified Stabilize the Foundation Soil without Drawdown as the preferred alternative. A summary of potential impacts associated with each of the alternatives is included in Table 1 Seismic Remediation-Summary of Impacts. Based on our initial analysis presented in this FEvR/FEIS, the Corps believes that the Stabilize the Foundation Soil without Drawdown alternative best meets the project purpose and needs, and most effectively avoids and minimizes adverse impacts on the environment. Implementation of the Stabilize the Foundation Soil without Drawdown alternative will ensure that there will be no loss of human life or property damage related to the uncontrolled release of the Tuttle Creek pool if a major seismic event should occur in the project area, it maintains the Congressionally authorized project purposes at their existing levels even after a major seismic event, and it avoids impacts associated with a drawdown of the lake during a 7-10 year construction period. The direct impacts of the construction activity would be very similar to the Stabilize the Foundation Soils with Drawdown and Enlarge Embankment alternatives, but the extensive adverse effects to recreation, fish and wildlife resources, and socio-economic impacts resulting from a 7-10 year drawdown of the pool would be avoided. The Corps has determined that from a strictly engineering perspective, the Stabilize Foundation Soil alternatives would provide a better fix than the Enlarge Embankment alternative. After completion of construction, the project would continue to be operated in accordance with the Congressionally authorized project purposes and would be expected to withstand a major seismic event and remain fully operational after inspection and with minimal expected repairs. Implementation of the interim measure, Dam Failure Warning System and Evacuation Plan will further ensure public safety beyond that

which can be achieved with the existing Emergency Action Plan until construction can be completed. Section 102 of NEPA, National Environmental Policy Act of 1969 Section 102, 42 U.S.C. Section 4332 (1994) mandates that the Corps, as an executive agency, comport with the policies set forth in the Act. Throughout this study, the Corps has strived to meet these NEPA goals. In Table 2 - Compliance of Preferred Alternative with Environmental Protection Statutes and Other Environmental Requirements is the Corps assessment of the preferred alternative's compliance with applicable laws and regulations. Based on this analysis, the Corps recommends implementation of the Stabilize Foundation Soil without Drawdown alternative. The Corps will consider all comments received in response to the DEvR/DEIS and FEvR/FEIS prior to making a final decision.

6. Hydrologic Adequacy

As part of the Dam Safety Assurance Study, the Corps reviewed our original inflow design hydrograph (IDH) and determination of the Probable Maximum Flood (PMF). A detailed description of this analysis is provided in Section 7-01.a, Section 7-02 a. and c., and 7-06 of the FEvR. More accurate methods for projecting the PMF have been developed since the original design study was completed. The Corps Dam Safety Regulations require that existing dams be routinely reevaluated using the latest technology to ensure that they will meet the required performance objectives during a major flood. Based on this study, the Corps determined that the PMF would result in a maximum flood elevation of 1,156.9 ft., m.s.l. This is approximately three feet higher than the original design calculation. The PMF is an extremely rare occurrence. Should this event occur there would be substantial property damage and potential loss of human life. The Corps' detailed analysis of the potential loss of life resulting from this hydrologic deficiency with a PMF event is included in Section 7-04.e. of the FEvR. With this new information, the Corps then proceeded to evaluate the various components of the dam to ensure that they would perform to the level required by the Corps Dam Safety Regulations in the event of a PMF.

The Corps identified minor deficiencies in the amount of available freeboard and repairs to the existing tainter gate system as necessary to assure performance of the dam during a PMF. Failure to address these deficiencies or taking "No Action" would result in a very high probability that Tuttle Creek Dam could be overtopped during the PMF, resulting in erosion of the dam and potential uncontrolled release of the pool. Unlike the seismic related dam failure, a dam failure associated with PMF would probably occur when most of the area on the Kansas River floodplain was already experiencing substantial flooding. During a PMF the tainter gate system would be making the maximum release, approximately 600,000 cfs. Although the Manhattan Levee System would not be damaged by seismic activity, the maximum release would probably result in overtopping of the levee. Unlike a seismic related failure that would occur unexpectedly and without warning, failure related to the PMF would be preceded by days or weeks of extremely heavy precipitation in the basin and continually rising lake levels and flooding on the Kansas River and tributary floodplains. This would give residents some warning time and would substantially reduce, but not eliminate, the potential

loss of human life and property. While damage to the dam itself would be less than a seismic related failure, there would still be major repairs required to restore the dam and similar effects associated with the temporary loss of benefits. The effects are lesser because it would be expected that substantial flooding of downstream areas would already be occurring prior to the PMF resulting in overtopping the dam and uncontrolled release of the pool.

The Corps also considered if these minor improvements would be required under all of the alternatives that were being considered to address the seismic stability of the dam. The Corps determined that under each of the action alternatives (Enlarge Embankment, Restricted Lake Operation, Stabilize Foundation Soil with Drawdown, Stabilize the Foundation Soil without Drawdown) increasing the available freeboard and making minor repairs to the existing tainter gate system would be required to comply with Corps' Dam Safety Regulations. Even under Restricted Lake Operation, starting with a 1,050 ft., m.s.l. multipurpose pool and routing the PMF through Tuttle Creek Lake only resulted in a reduction of a few inches in the expected peak elevation of the lake associated with the PMF. While the Corps may complete these proposed minor repairs concurrent with the alternative selected to address seismic stability of the dam, the Corps has determined that these minor actions have independent utility and may be considered separately under NEPA. In addition, the Corps has determined that each of these activities is categorically excluded from NEPA review. The Corps has determined that this proposed work is consistent with criteria outlined in 33 CFR Parts 230 and 325, Environmental Quality; Procedures for Implementing the National Environmental Policy Act; Final Rule, Federal Register, 3 February 1988, Section 230.9[b] Categorical exclusions, which states "Activities at completed Corps projects which carry out the authorized project purposes. Examples include routine operation and maintenance actions, general administration, equipment purchases, custodial actions, erosion control, painting, repair, rehabilitation, replacement of existing structures and facilities such as buildings, roads, levees, groins and utilities, and installation of new buildings utilities or roadways in developed areas." The following provides a description of the proposed method to increase available freeboard and the tainter gate system repairs.

6.1 Available Freeboard

One area where the Tuttle Creek dam was identified as being deficient was the amount of available freeboard considering the PMF. Freeboard is the area between the estimated top of pool during the PMF and the top of the dam. Freeboard is used to account for wind and wave action that could wash water across the top of the dam, eroding it, and potentially resulting in dam failure and uncontrolled release of the pool. Having additional dam height above the expected elevation of the PMF prevents wind and wave wash from overtopping the structure, which could erode it potentially to the point of failure. Based on this study, and our current Dam Safety Regulations, the Corps determined that the existing freeboard on Tuttle Creek dam was insufficient to ensure adequate performance during the PMF. Considering the most up to date analysis of the PMF, currently there is 2.2 feet of freeboard and Corps Dam Safety Regulations require 4.6 feet. The Corps

then looked at ways that this deficiency could be addressed. Initial screening level analysis eliminated additional spillway bays, perched auxiliary spillways, and increasing the height of the dam with earthen fill because of high cost. Based on past experience at other Corps lakes, the most cost effective, least environmentally damaging alternative to address freeboard infringement problems has been the use of anchored "Jersey barriers".

The Corps proposes to increase the available freeboard of the dam to ensure that it will perform to the level required by Corps Dam Safety Regulations in the event of a PMF. The Corps has made a preliminary determination that the proposed use of "Jersey barriers" to increase the amount of available freeboard on Tuttle Creek dam has independent utility and therefore can be considered separately for compliance with the requirements of the National Environmental Policy Act (NEPA).

Increasing the height of the dam to provide the required freeboard for wind-driven waves would require the placement of 8,000 linear feet of 32-inch high, concrete "Jersey barriers" across the top of the dam. A shallow narrow trench would be excavated and the spoil material disposed of off-site. Concrete footings would be poured in place in this trench on the upstream side of the existing roadway and the "Jersey barriers" would be anchored to these footings. Drains would be incorporated into the footings to ensure drainage of water from the road surface. This "Jersey barrier" wall would also serve as the safety guardrail for the road and would meet highway safety standards as required by the Kansas Department of Transportation. Currently there is a narrow shoulder and a steel guardrail on wooden posts across the top of the dam on the upstream side. This guardrail would be removed and disposed of. The "Jersey barrier" wall would replace the steel guardrail for traffic safety purposes. No parking is currently allowed on the shoulder of the dam road except at the designated turnout areas at each end of the dam. Construction of the "Jersey barrier" wall would require the temporary closure of a portion of one-lane of the dam road for approximately 4 months. Estimated cost to complete the project is \$1,875,000. Construction could begin as early as the Summer of 2003. It should be noted that the "Jersey barrier" wall proposed to increase the effective freeboard of the dam is designed solely to prevent wind and wave wash across the top of the dam. It is in no way designed or capable of increasing the level of the lake, increasing the flood pool capacity of Tuttle Creek Lake or to have standing water against it.

This method has the lowest cost and the least environmental effect. As a result of community input, the height of the barrier has been reduced to only that necessary to withstand wave action. The barrier will not obstruct the view of the lake. The modifications necessary to increase the available freeboard of Tuttle Creek dam involves replacement of the existing steel guardrail with a "Jersey barrier" wall. As such, the impacts to the environment and the surrounding community are extremely limited. The proposed work would ensure that the project would be capable of carrying out the authorized project purpose, i.e. flood control, to the level required by Corps dam safety regulations. The Corps has determined that increasing the amount of available freeboard on Tuttle Creek dam by constructing a

“Jersey barrier” wall across the crest of the dam has independent utility and therefore can be considered separately for compliance with the requirements of the National Environmental Policy Act (NEPA).

In addition, the Corps has determined that increasing the amount of available freeboard on Tuttle Creek dam by constructing a “Jersey barrier” wall across the crest of the dam, meets the criteria to be categorically excluded from National Environmental Policy Act documentation. The Corps has determined that this proposed work is consistent with criteria outlined in 33 CFR Parts 230 and 325, Environmental Quality; Procedures for Implementing the National Environmental Policy Act; Final Rule, Federal Register, 3 February 1988, Section 230.9[b] Categorical exclusions, which states “Activities at completed Corps projects which carry out the authorized project purposes. Examples include routine operation and maintenance actions, general administration, equipment purchases, custodial actions, erosion control, painting, repair, rehabilitation, replacement of existing structures and facilities such as buildings, roads, levees, groins and utilities, and installation of new buildings utilities or roadways in developed areas.”

6.2 Tainter Gate System

As outlined in the FEvR, the project utilizes 18 tainter gates to pass severe flood events without damage to the dam, and there are identified structural deficiencies with those gates. Additional hydrological studies found that the hydrologic deficiency of the project could be seriously exacerbated by gate failure. Basically, if two of the 18 gates failed during a PMF it would be very likely that the dam would be overtopped resulting in erosion of the dam and potential uncontrolled release of the pool.

The Corps proposes to repair the tainter gate system to ensure that it would perform to the level required by Corps Dam Safety Regulations in the event of a PMF. This work would be confined to repairs on the existing 18-gate system to ensure that it meets current Corps’ structural adequacy criteria. The modifications necessary to strengthen the tainter gates involve only stripping, welding, painting and other work directly on the gates themselves. Repainting operations would involve the generation, treatment, and disposal of lead paint waste above the Resource Conservation and Recovery Act (RCRA) Land Disposal Restriction (LDR) Toxicity Characteristic Leaching Procedure (TCLP) limits. All waste generating activities will be conducted in accordance with all applicable local, state, and Federal regulations. The impacts to the environment and the surrounding community, as a result of the tainter gate system repair, are extremely limited. Repair work would ensure that the project would be capable of carrying out the authorized project purpose, i.e. flood control, to the level required by Corps dam safety regulations. Repair work could begin as early as the summer of 2003 and would be completed in approximately 12 months. Estimated costs to complete the project are approximately 6 million dollars. The proposed tainter gate repairs could require short-term temporary closure of State Route 13 across the top of the dam. The Corps has determined that the repair of the tainter gate system has

independent utility and therefore can be considered separately for compliance with the requirements of the National Environmental Policy Act (NEPA).

In addition, the Corps has determined that the repair work proposed for the tainter gate system, meets the criteria to be categorically excluded from National Environmental Policy Act documentation. The Corps has determined that this proposed work is consistent with criteria outlined in 33 CFR Parts 230 and 325, Environmental Quality; Procedures for Implementing the National Environmental Policy Act; Final Rule, Federal Register, 3 February 1988, Section 230.9[b] Categorical exclusions, which states “Activities at completed Corps projects which carry out the authorized project purposes. Examples include routine operation and maintenance actions, general administration, equipment purchases, custodial actions, erosion control, painting, repair, rehabilitation, replacement of existing structures and facilities such as buildings, roads, levees, groins and utilities, and installation of new buildings utilities or roadways in developed areas.”

7. Dam Failure Warning System and Evacuation Plan

As noted in Section 1.10 Interim Measures, above, the Corps reviewed the existing Emergency Action Plan and attempted to identify any practicable interim measures that could be implemented to increase public safety. The Corps also determined that for any interim measure to be truly effective, it must further ensure public safety beyond what can be achieved through the existing EAP, it must be able to be quickly implemented (i.e. it shouldn't take five years to design and construct) and it must have minimal environmental impact. The purpose of the interim measure is to address potential seismic related failure and is not related to measures being considered under Section 6. Hydraulic Adequacy, for which the Corps has determined the existing EAP is adequate. The interim measure would enhance public safety until such time as permanent repairs or changes in operation that are being proposed in the FEIS could be implemented. Even under the “No Action” Alternative, i.e. should funding delay or preclude the implementation of alternatives being considered in the FEIS, the Dam Failure Warning System and Evacuation Plan would provide long-term benefits to public safety. For the Restricted Lake Operation alternative the Corps realizes that although the risk of a seismic related dam failure could be greatly reduced by establishing a new multi-purpose pool elevation of 1,050 ft., m.s.l., by continuing the flood control mission, there would be times when the pool is above this elevation. The Dam Failure Warning System and Evacuation Plan would enhance public safety during times when the pool was above elevation 1,050 ft., m.s.l. Under the Stabilize Foundation Soil with Drawdown and Stabilize Foundation Soil without Drawdown alternatives the Dam Failure Warning System and Evacuation Plan would increase public safety until such time as the construction activity could be completed.

The proposed dam failure warning system described below is a conceptual design, not an actual construction design. Specific details (i.e. type, number, and location of sensors, siren locations, etc.) will be determined during final design. The following description will provide the reviewer with the type of work and potential

effects associated with a proposed Dam Failure Warning System of this type. The proposed dam failure warning system will consist of three major elements; an automated data acquisition system (ADAS), a video surveillance system with alarm activation stations, and a siren system. All communication in the proposed dam failure warning system is by VHF radio to prevent the loss of a signal because of broken wires during the earthquake. All equipment will be connected to 120 volt AC power with battery backup in the probable event of loss of AC power.

The ADAS consists of sensors with measurement and control units (MCUs) to detect an earthquake, foundation pressures, embankment movement, and a gateway MCU. Three types of sensors will be used in the system; vibration monitors to detect if an earthquake has occurred, deformation monitors to detect an embankment failure, and pressure transducers to detect pressure in the dam. Each sensor has an associated MCU. The data collected by the sensors are stored in these MCUs. The gateway MCU uses a voting system to determine if an alarm is sent to the network monitoring system (e.g. three out of five sensors must detect damage to the dam before an alarm signal is sent).

Video cameras, with daylight and nighttime capability, will be located along and at each end of the dam. The cameras will be positioned in such a way that the upstream and downstream embankment can be viewed. The cameras will have pan-tilt-zoom capabilities. The video feed and alarm signal from the gateway MCU are sent to the network monitoring system. The video feed and sensor data will also be accessed remotely through the Internet. The sirens can be sounded at any of four alarm activation stations. The locations of these stations will include the project office on the west abutment, on the east abutment, the sheriff/fire departments, and via secure Internet access.

The siren system consists of a control console and approximately 12 sirens. The sirens will be placed in a pattern to broadcast a warning to the threatened area where the majority of the at-risk population lives. The sirens will have voice capability so a message can be broadcasted indicating that the dam had failed and to evacuate the area. This message capability avoids confusion with other signals.

In normal operations, the sensors will collect data infrequently such as twice a day. When an earthquake triggers the vibration sensors the ADAS will go into alert mode, collecting data on a higher frequency basis such as once a minute. If the embankment deformation or pressure sensors detect a failure, the MCU will radio an alarm signal to the gateway MCU. The gateway MCU will analyze the incoming alarm signals and use preprogrammed system logic to determine if an alarm should be sent to the network monitoring system. This system logic is used to lower the chances of a false alarm being sent to the network monitoring system. If the gateway MCU determines the sensors have detected an actual dam failure, a signal will be radioed to the network monitoring system.

The network monitoring system will be located at the project office. Project personnel will receive the incoming alarm signal and use the video cameras and sensor data to determine if the alarm should be sent to the sirens. This is one more

6047 step to avoid a false alarm. The automatic system will not be able to sound an
6048 alarm without human intervention. The system will alert a person(s) and the alarm
6049 can only be sounded by a person.

6050
6051 The gateway MCU will also send an alarm signal to the emergency
6052 management office in the Kansas City district office. Personnel in this office can
6053 receive the video feed and sensor data via the Internet to determine if the dam is
6054 failing. If it is determined that the dam is failing, they can activate the sirens.

6055
6056 If the Tuttle Creek Lake project personnel or the emergency management
6057 office personnel determine that the dam is going to fail, they can activate the siren
6058 system. This will radio a signal to the siren control console and the sirens will be
6059 activated.

6060
6061 The siren system can be activated at two other locations, a separate
6062 structure on the east abutment and by the sheriff/fire departments. Neither of these
6063 locations will have the capability to view the video feed or sensor data. These alarm
6064 activation locations are for redundancy.

6065
6066 The exact costs for the proposed dam failure warning system cannot be
6067 determined until the actual design is formulated, however, the costs are estimated
6068 at \$1.7 million to obtain an operational system and approximately \$15,000 per year
6069 for operation and maintenance.

6070
6071 The proposed dam failure warning system is intended to be an interim
6072 measure during completion of the study and construction as described under
6073 Enlarge Embankment and both Stabilize Foundation Soil Alternatives described in
6074 the EIS. If one of the proposed construction alternatives is selected, the dam failure
6075 warning system would be operated and maintained by the Corps until construction
6076 is complete. Upon completion of construction, the dam failure warning system
6077 would be turned over to the local emergency management agencies for
6078 incorporation into the local community warning system. If the "No Action" or
6079 Restricted Lake Operation alternative is selected, the dam failure warning system
6080 would be operated and maintained indefinitely by the Corps.

6081
6082 In addition to the dam failure warning system, the Corps will coordinate with
6083 State and Federal emergency management agencies, local governments, law
6084 enforcement agencies, and media in the project area to develop an evacuation plan
6085 that specifically addresses a seismic related dam failure.

8. Comments and Responses on the DEvR/DEIS

Copies of the actual comments are included in Appendix J. Comments are sorted by general subject below.

TUTTLE CREEK DAM SAFETY ASSURANCE PROGRAM **COMMUNITY AND AGENCY COMMENTS ON** **DRAFT EVALUATION REPORT AND** **DRAFT ENVIRONMENTAL IMPACT STATEMENT** **DATED APRIL 2002**

NON-DAM SAFETY RELATED

C: How can I get a copy of the Manual that tells the Corps of Engineers how to regulate the release of water? Norman F. Marstall by Comment Card at 02 May 2002 Community Meeting.

R: A copy of the manual was provided.

C: What is the projected remaining life of Tuttle Creek Reservoir? Comment Card at 02 May 2002 Community Meeting.

R: In general, it is believed that earth embankment dams like Tuttle Creek Dam can remain in operation for well in excess of one hundred years. The application of current sedimentation rates indicates that the lake will be filled with sediment to the current lake level in 50 to 100 years depending on the sedimentation pattern. However, Tuttle Creek lake can continue to provide flood control and other project purposes for decades. A complete discussion of this issue is included in Section 4.4, "Cumulative Impacts" of the Environmental Impact Statement.

C: Also, how important in the Corps' mission today is provision of water for navigation (barges downstream I assume)? Hasn't the expense of operating barges today changed the importance of this part of your mission? Comment Card at 02 May 2002 Community Meeting.

R: Tuttle Creek Lake is a multipurpose project. Supplemental releases from Tuttle Creek Lake to support navigation on the Missouri River are one of the Congressionally authorized purposes of the Tuttle Creek Lake project. Project purposes are not ranked and all purposes are considered to be of equal importance. The economic value of the benefits of each project purpose varies over time with the fluctuation of many factors.

6103

C: 6 authorized purposes were listed? Can you rank them so far as priority?
Comment Card at 02 May 2002 Community Meeting.

R: Tuttle Creek Lake is a multipurpose project. Supplemental releases from Tuttle Creek Lake to support navigation on the Missouri River are one of the Congressionally authorized purposes of the Tuttle Creek Lake project. Project purposes are not ranked and all purposes are considered to be of equal importance.

6104

C: What will be done at the tubes? Comment Card at 02 May 2002
Community Meeting.

R: Modification of the outlet works (the tubes) is not anticipated.

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C: I read the article on the Tuttle Creek Dam project with special interest. My family owns the pasture adjacent to the Tuttle Cove Corps' land. If you do build 50 additional campsites in the Tuttle cove area, perhaps you would be interest in trading some land (See Map). This would give you more room to build those campsites and give us access on the east side of our pasture. Robert D. Sumners by letter.

R: Comment Noted.

6106

C: My family is a victim of the 93 TCD "runaway", at the Rocky Ford Dam area, suffering: loss of a structure unaffected by the 1951 flood; damage to remaining structures unaffected by all floods dating back to the turn of the century (1900); and instability of the remaining riverbank threatening the remaining structures including the Rocky Ford Dam. To date the US Government have spent millions filling the hole immediately below the TCD spillway, but not a dime to rehabilitate the immediate downstream discharge district including the weakened Rocky Ford Dam. I take great exception to the Corps of Engineers' efforts to effectively "harden" the TCD and "improve" the TCD Spillway in the manner proposed, because the net result will ultimately be the: - impounding of water at a higher elevation (because of the unchecked silted-in/reduced-impounding TCD capacity). - creation of a more forceful discharge (because of the higher virtual kinetic energy of an elevated stream flow within ponding) through the TCD Spillway. - another engineered forceful spillway discharge/run-away rather than a natural river rising and spreading throughout the valley type flood! Would you please consider the following and kindly respond: The TCD was designed to be a 50 year dam; built with full knowledge that it would silt-in in those 50 years and end up with a reduced capacity to impound water. Questions: 1. Why wasn't a PLAN for the "maturation" of TCD a part of the original engineering of TCD? 2. If the engineering of the original TCD is still considered to have been "correct", (and nothing released to the public indicates the Corps of Engineering made any mistakes in their original design) why isn't the PLAN simply to "dredge" the lake to the original elevation and acre feet holding capacity? 3. Has an

economic analysis ever been performed to compare the cost of "dredging" vs. the costs of "hardening" the dam? 4. Has it ever been considered that quite possibly the silt is a valuable commodity and is made up of the most fertile soil in the Midwest, and might have value being dredged/dried and sold/given back for Agricultural supplement in the region of depletion? 5. Has it ever been considered that if not sold for agricultural supplement, that the silt could be dredged/dried and used by industry for government mandated reclamation projects? 6. Has the volume of 40 year contracts of two coal trains a day passing through Manhattan, Kansas on their way to Jeffery energy center and returning empty back to a big hole in the ground in Wyoming, ever been compared with the TCD silt-in volume and then been analyzed in cost comparison with the current TCD hardening project? 7. Has it ever been considered that just maybe there is a capitalistic venture hidden in reclamation of dams, rather than yet another tax burden for Americans? 8. Recent archeological evidence suggests that the ocean may flooded in the Black Sea cradle of civilization area that was below sea level and was responsible for the cataclysmic chain of events responsible for "Noahs Flood". Either way, archeologically or religiously speaking, the US Government is strongly advised to refrain from any references to Biblical events in its engineering studies. TCD is in the Midwest, not the Middle East. Final concern. If the TCD dam was only a 50 year dam, and the Corps of Engineers silt-in calculations are frighteningly accurate compared to what has really occurred...then please tell me what the Corps of Engineers intends to do with the next 50 years of silt and an entire lakebed elevation significantly above that of the valley below? Build the dam yet higher and make it yet harder to accommodate it? R. David Sager DMD by E-mail.

R: The depth and extent of flooding in the Manhattan area was significantly less in 1993 than it was in 1951. The flow from the 1993 Tuttle Creek spillway discharges was significantly less than the natural inflow to Tuttle Creek lake, thus, the presence of Tuttle Creek Dam significantly decreased the extent of flooding that would have been experienced had the dam not been present.

In discussions with the owner of Rocky Ford Dam, the Kansas Department of Wildlife and Parks, we have not received any information indicating that the structural integrity of Rocky Ford Dam was damaged by flows in 1993.

The Corps of Engineers is not Congressionally authorized to compensate property owners for flood damages. The Federal Emergency Management Agency is authorized to mitigate and compensate flood damages.

None of the considered alternatives to address the issues at Tuttle Creek Dam involved providing for or increasing the capability of the dam to hold a higher lake level. Lake level management changes are not proposed. Therefore, there will not be any ability to increase the velocity of discharges due to higher lake levels.

The velocity of the water discharged through the spillway is decreased as the water flows through the river pond. Since the spillway discharge in 1993 entered the natural river channel before flowing downstream, and since the discharges were less than the inflow to the lake, the velocity and “force” of the water downstream of the dam was actually less than it would have been had the dam not been present.

Tuttle Creek Dam was designed with an ECONOMIC life of 100 years meaning that the costs of building and operating the project were only compared to benefits to be gained from the project for 100 years. In general, it is believed that earth embankment dams like Tuttle Creek Dam can remain in operation for well in excess of one hundred years.

1. The “maturation” of Tuttle Creek Dam was considered during the original design as it is for all dams and reservoirs. However, as the time approaches, many years from now, that Tuttle Creek Dam can no longer effectively provide the authorized project purposes, a detailed evaluation such as an Environmental Impact Statement or other process that is applicable at the time, will be required to determine the appropriate disposition of the dam and reservoir.

2. Siltation of the lake has only minimally impacted the flood control storage in Tuttle Creek lake. Even if the lake were dredged to its original storage volume, the need to provide wave protection on the top of the dam would remain and dredging would not address the seismic risks.

3. The cost of dredging material for use in stabilizing berms on the dam was considered and found to be far in excess of the cost of using local upland borrow and would be significantly greater than providing wave protection on the top of the dam.

4. We are unaware of any significant value to silt that would exceed the costs of dredging the material. Private businesses are allowed to operate concessions on Government lands by lease or license. Any business opportunities associated with dredging and selling silt could be presented for concession consideration.

5. As with the previous response, any industry that has an interest in the silt in Tuttle Creek Lake is free to pursue a license or lease with the Government to pursue the material.

6. The need for silt to fill in coal mines in Wyoming has not been considered in these analyses.

7. Any capitalistic venture that may be present in the reclamation of dams remains available to private enterprise when the time comes to address dams that no longer fulfill their authorized purposes.

8. Tuttle Creek Dam was designed with an ECONOMIC life of 100 years. Siltation of the lake has only minimally impacted the flood control storage in

Tuttle Creek Lake. In general, it is believed that earth embankment dams like Tuttle Creek Dam can remain in operation for well in excess of one hundred years. Current projections indicate that Tuttle Creek Dam should exceed that age before the flood control storage in the lake is significantly impacted.

6107

C: I think the Corps needs to have a plan in place that would address the sedimentation problems from the north both interstate and intrastate. The state of Kansas has had significant problems dealing with Nebraska in this area. As a federal entity the Corps might be in a better position to address the problem of excessive sedimentation and the associated pollutant problems. Ken Hays, Project Impact Survey response by E-mail.

R: Sedimentation in Tuttle Creek lake was considered during the project's original design and it has only slightly impacted the flood storage. The Corps of Engineers is not authorized to evaluate or implement land use management practices on private land. Sedimentation management will not address seismic or hydrologic risk.s

6108

C: Why weren't the outlet tubes used more in 1993? Harold Merts, Verbal Comment at 02 May 2002 Community Meeting.

R: Water releases are managed in accordance with the approved Reservoir Regulation Manual. When the lake increases into the flood control pool, the lake must be managed in strict accordance with the Manual. Releases in 1993 were made in strict guidance with the Manual. Releases made while the lake is below elevation 1136 must consider downstream conditions. Therefore, releases may be limited if flooding conditions exist downstream. When the lake reaches 1136, releases must be made through the spillway to avoid overtopping of the spillway gates.

6109

C: You need to change the Manual (Reservoir Regulation Manual). Water was in my finished basement in 1993 for three weeks. In the '51 flood it was there for three days. Unknown from Wamego. Verbal Comment at 02 May 2002 Community Meeting.

R: The maximum inflows into the reservoir in 1993 were approximately 100,000 cubic feet per second. The maximum outflows from the dam were approximately 60,000 cubic feet per second. Tuttle Creek Dam reduced the peak flood flow by 40 percent. Although the duration of high water may have been longer, the depth of the floodwater was reduced. There have been numerous events where peak inflows to the lake were stored within the lake such that there was no flooding downstream when there would have been without the dam.

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C: Was the manual rewritten after the '93 flood? Don Ritticher, Verbal Comment at 02 May 2002 Community Meeting.

R: The Reservoir Regulation Manual was not revised in response to the 1993 flood. In 1994, a review of reservoir operations during the 1993 flood was completed. It was concluded that the flood control plan for Tuttle Creek was adequate and was sufficient for future floods of the magnitude of the 1993 flood. The Tuttle Creek Water Control Manual was revised in 1995 as a result of the purchase of water supply storage by the Kansas Water Office. The changes to the document addressed water supply, water quality, and navigation. Most of those changes were implemented in the early 1990s but the final manual revisions were not completed until 1995.

6112

C: Has there ever been a Probable Maximum Flood? Don Ritticher, Verbal Comment at 02 May 2002 Community Meeting.

R: There are documented examples of floods occurring in other parts of the United States that were equivalent to the computed Probable Maximum Flood for that area. However, by definition, if a flood occurs which approaches the level of the Probable Maximum Flood, the calculation should be reconsidered since the flood that is the worst that could ever happen would most likely be larger than what has already occurred.

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C: How far was it from the top of the dam in 1993? Unknown Verbal Comment at 02 May 2002 Community Meeting.

R: Approximately 23 feet.

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C: Would the water treatment plant and wastewater treatment plant be inundated and out of service in the event of a dam failure after an earthquake? Jack Messer, Verbal Comment at 02 May 2002 Community Meeting.

R: Yes

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NATURAL RESOURCES/ECONOMICS/IMPACTS

C: You indicated that there are 13,000 people involved and potentially 400 lives involved. Are those in the Manhattan area or farther downstream and is that current data? Manhattan and Riley County is growing rapidly. Alvin Johnson, Verbal Comment at 02 May 2002 Community Meeting.

R: An exact breakout of the population at risk is presented in the report. The vast majority of the population at risk is along the Big Blue River between the dam and the Kansas River. The population at risk was calculated based on the 1990 Census data and the population has increased significantly since that time.

6119

C: Lowering lake level will impact "Fishery", "Recreation" and "Aesthetics". Please elaborate on the economic impacts to each of these with respective dollar amounts. Comment Card at 02 May 2002 Community Meeting.

R: The economic impact to the surrounding community of lowering the lake level was not specifically calculated. The reduction of construction costs realized by lowering the lake was calculated to be between \$3 and \$5 million. The measures recommended by the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service to mitigate the impacts of lake drawdown on the fishery and recreation were estimated to greatly exceed \$5 million. This negative benefit/cost ratio, combined with several engineering and implementation concerns, lead to elimination of lake drawdown from the preferred alternative.

6120

C: I am concerned about the impact the dam construction project will have on the local road system? Comment Card at 02 May 2002 Community Meeting.

R: The project is expected to add approximately 30 tractor-trailer trips per day during most of the project duration and incidental passenger and commercial traffic to the area. Given the relatively high traffic volumes on Tuttle Creek Boulevard and Highway 13, this addition to traffic counts is not expected to cause significant impacts to the area road system. The Corps of Engineers will coordinate with the Kansas Department of Transportation and the counties to consider project access, haul routes, and road conditions.

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6122

C: As a homeowner at Tuttle Creek, how noisy will the project be? Comment Card at 02 May 2002 Community Meeting.

R: The exact noise levels cannot be predicted and are most likely dependent upon wind direction and speed, cloud cover, time of day, humidity, and other uncontrollable conditions. However, a similar project at a lake in Oregon was recently visited and noise levels were evaluated. The loudest operations were found to be the diesel engines of the equipment and the backup alarms on the equipment. The diesel engines would be similar to, or less than, the sounds of tractor-trailers on the highway crossing the dam. The backup alarms are intended to be heard for some distance for safety purposes. We will continue to consider noise concerns as this project progresses through construction.

6123

C: Wastewater Plant & Water Plant are shown in inundated area if dam fails. Did you consider implications on water supply & sewer service for City of Manhattan if dam fails? Comment Card at 02 May 2002 Community Meeting.J

R: While we did note the presence of these facilities in the impacted area, we did not specifically consider the implications of the loss of these facilities due to flooding after dam failure. It is likely that these services would be significantly disrupted by the initial earthquake event.

6124

C: Will the Beaver Pond be eliminated by the proposed injection of concrete into the Dam? Will the seepage that feeds this pond stop? David Ring by Comment Card at 02 May 2002 Community Meeting.

R: The River Pond will not be eliminated by this work. The level of the River Pond is controlled primarily by discharge through the outlet works (the tubes) and is not likely to be significantly impacted by this project.

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C: What sort of impact, both short-term and long-term, effects will this have on the water levels, use, access to the river pond areas??? Comment Card at 02 May 2002 Community Meeting.

R: A plan for offsetting impacts to the use of the River Pond area (primarily camping facilities) has been agreed to with the Kansas Department of Wildlife and Parks. This plan is documented in the Environmental Impact Statement. Access to the River Pond area will be slightly altered. However, access to the area from both the west and the east will remain.

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C: From the standpoint of residential areas above the dam, it would be extremely advantageous to limit construction to 5 days/wk to minimize impact when recreation is at its peak on weekends? Comment Card at 02 May 2002 Community Meeting.

R: Construction sequencing and scheduling will not be performed until development of the construction contract or mobilization of a contractor to the site. However, construction sequencing and scheduling will consider impacts to residential areas and recreation usage. If it is possible to capitalize on the seasonal changes in recreation and outside residential activities, we intend to pursue that possibility.

6128

C: Tuttle Creek is a dirty lake. The water level fluctuates frequently, impacting fishing, wildlife and recreation. What could you possibly do to the lake that would impact it worse than it is now? Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted.

6129

C: The Environmental Protection Agency has reviewed the Draft Environmental Impact Statement for the Tuttle Creek Dam Safety Assurance Program. Our review is provided pursuant to the National Environmental Policy Act (NEPA) 42 U.S.C. 4231, Council on Environmental Quality (CEQ) regulations 40 C.F.R. Parts 1500-1508, and Section 309 of the Clean Air Act (CAA). The DEIS was assigned the Council on Environmental Quality (CEQ) number 020153.

The DEIS analyzes five alternatives that would minimize the potential for loss of human life and property damage in the event of a major earthquake. Based on our overall review, the EPA has rated the Draft Environmental Impact Statement for this project LO or "Lack of Objections". A copy of EPA's rating descriptions are provided as an enclosure to this letter. The EPA feels the preferred alternative of stabilizing the dam foundation without drawdown would meet the project's purpose and need, as well as present the least impacts to the natural environment. The EPA is providing comments which may assist in improving the decision making value of your final EIS, and increasing public disclosure of project impacts.

The EPA commends the work of all those persons and agencies involved in the process leading to the development of the DEIS.

Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: Comment Noted.

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C: The Tuttle Creek Reservoir is listed as being impaired because it does not meet the four water quality standards parameters of Eutrophication, Sedimentation, and Atrazine/Alachlor. Due to the existing impairment of the reservoir, the EPA would like to reiterate the importance of adhering to the specific mitigation practices outlined in the water quality section of this document. Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: Comment noted. We intend to comply with all of the commitments made in these documents.

6132

C: The installation of a groundwater cutoff wall in order to stabilize the foundation of the dam could have an impact on the water level of the River Pond. The document does state that a decrease in water level would only happen during drier periods, but the probability and severity of this impact is still unclear. If this water level decrease were to be viewed as a significant impact, then how would issues regarding surface water, aquatic habitat and recreation be mitigated? Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: The level of River Pond and the groundwater level more than a few hundred feet downstream of the dam are influenced primarily by discharges through the outlet works of the dam. During extreme drought conditions, it is likely that releases from Tuttle Creek would be necessary to maintain water quality standards. The spillway crest of Rocky Ford Dam downstream of Tuttle Creek Dam essentially sets a minimum water level in the River Pond as long as releases are being made from Tuttle Creek Dam. It is impossible to quote any meaningful numbers regarding the probability and severity of potential decreases in River Pond water levels in extreme drought situations without an exhaustive groundwater model of the region. A decrease in the water level in River Pond caused by a decrease in seepage below the dam would only occur in extreme situations where releases from the reservoir could not be made (such as if the lake were dry) and the water level upstream of Rocky Ford Dam fell below the spillway crest. In that extreme drought case, as is the case for extreme floods, the impacts to surface water, aquatic habitat, and recreation could not be mitigated.

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C: The reduction to the availability of groundwater and the potential pH change due to the stabilization construction of the dam could impact the water supply well for the River Pond State Park redeeming it a non-source for quality drinking water. The EPA would like to see more detail on how the state park would be reconnected to the water supply system along Dryer Road in order to abate potential environmental impacts. Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: Detail will be added to the EIS. The connection will be made by abandoning the existing well in compliance with state and federal standards and simply connecting the existing distribution system within the park to a rural water distribution main along Dyer Road. This connection will be made prior to abandonment of the existing well.

6135

C: The EPA would suggest that the proposed batch plant be constructed in a isolated area away from recreational areas in order to avoid human exposure to pollutants and noise. In addition, the final EIS should identify specific dust control measures that would be implemented at the construction site and batch plant. Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: The "batch plant" is not at all like a conventional batch plant in that it is much smaller and has only a generator, pump, and air compressor that generate noise. Airborne dust is limited since the "batch plant" is actually mixing wet cement grout and the transfer of dry cement is entirely contained. The grout plant must be within 1000' of the drilling operations since the grout cannot be pumped farther than that. Dust will only be generated by truck traffic and earthmoving operations. A visit to a similar project in Oregon has confirmed these statements. Typical dust control measures will be those required by any large earthmoving operation. These typical measures will be outlined in the EIS. The drilling operation and soil stabilization operation is a wet process that does not generate dust.

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C: Recreational impacts to the River Pond State Park and the Outlet Park are significantly adverse. The EPA encourages continued coordination with the Kansas Department of Wildlife and Parks to insure that the area maintains its recreational appeal during and after construction of the project. We would also like to see coordination with KDOT, as well as the general public, on the proposed rerouted or new access roads to the area. Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: An agreement with the Kansas Department of Wildlife and Parks has been reached to offset potential impacts. This agreement is documented in the revised report. Coordination with KDOT on traffic impacts has begun. Given that KDOT has at least one major project planned in the time frame of this project (a bridge replacement), this coordination will be on-going throughout the design and implementation of the project. We will also work with the counties and the City of Manhattan on any proposed road changes as they develop during design. We will continue to work with all appropriate agencies and the media to ensure that the public is informed of the process.

6138

C: The Environmental Justice Section of this project is very limited in indicating the overall socioeconomic status of the area, and in determining any potential impacts to minority and/or low-income populations. The document only goes as far as saying, "the poorest residents live in the floodplain, while the more affluent residents live in elevated areas". The EPA would like to see this section re-worked to fully capture the actual socioeconomic status of the area. Nicholas Rocha, Environmental Services Division, Environmental Protection Agency, Region VII, by letter.

R: In cooperation with the Environmental Protection Agency, additional information has been provided in the reports.

6139

C: In response to your request for comments regarding the proposed Tuttle Creek Dam Project, I Charlie Burgess, d.b.a. Kansas River Outfitters, submit the following: I am a Licensed Concessionaire in the Tuttle Creek State Park-River Pond and have been in my current location in the River Pond basin four years. My customers are the 500,000 people that visit the park each season for the purpose of camping and other recreation. I think it is significant that the increase in the number of visitors to this facility in the last four years far surpasses the visitor increase to any other similar facility in the State of Kansas. Most of the credit for this phenomenal growth goes to this beautiful piece of real estate and the manner in which it has been managed by the fine people who run this park; but I also like to think that the services I provide have contributed to this growth in some small measure. Growth such as this does not happen overnight and does not happen by magic. The way you get growth numbers like these is by providing a quality product where there is a demand for such a product, such that those who visit once will want to visit again; and by making the facility so accommodating that those who do visit will be compelled to tell others of their

experiences here at the park. At the same time, these growth numbers make obvious the community need for this facility. I feel that my contact with the thousands of park visitors over the last four years has given me unique insight as to why this park has experienced extraordinary growth in the past few years. I have deep concerns with the Corps' plans for this park. While I clearly understand the necessity for upgrades to the Tuttle Creek Dam, I take issue with the current proposal in several respects. My first, and by far most important, concern has to do with the environmental impact the project is expected to have on this park. The people who come to this park are environmentally minded people that are not likely to spend their time at a construction site. These visitors come to the River Pond to see the eagles, deer and falcon; they come for the serenity and beauty that this park offers. They come to fish, hike, camp, canoe and kayak, play the nicest Frisbee golf course in this area, swim and share quiet moments. Simply put, and as silly as it may sound to some, they come to commune with nature. The experiences available in the River Pond basin improve the quality of life for the people in the community that is northeast Kansas. The true, albeit daunting, task for the U.S. Army Corp of Engineers should be to make Tuttle Dam safe and at the same time maintain the beauty that can be found in the River Pond basin; or provide alternate and equally beautiful place where the citizens of the community can escape from the pressures generated by everyday life. If one tramples the plants while building the garden, there is no point to the garden in the first place. If construction at Tuttle Dam lowers the water quality in the River Pond basin, even the slightest bit, aquatic life will suffer. If the aquatic life is degraded, the fowl and animals that feed on the aquatic life will disappear. The waterfowl will leave, as will the eagles and the falcons. If air quality is degraded and undesirable noise is created as a result of the operation of construction equipment, the land creatures will leave; and the human beings will be among those land creatures that will no longer be plentiful in the River Pond basin. Unless steps are taken to protect this unique environment, or in the alternative provide for an equally serene environment, those who visit this park will not visit again; and the same work-of-mouth that has over the last few years been responsible for spectacular increases in the number of visitors, will cause those visitor numbers to fall like a rock over the spillway. It is true that approximately seven to ten years after the project begins, it will end. When the project is finally over, presumably, northeast Kansas will once again have a showcase recreational facility such as the one that exists today. However, under the current plan it will take many years beyond the completion date of the project before the wildlife returns to the levels present today. Additionally, it will take many hears of hard work by dedicated people, such as Todd Lovin and others who are currently associated with the park, to rebuild public interest in the park to the level at which it stands today. In the mean time however for a period of ten to twenty years, this community, under the current plan, will be deprived it of a facility that has done so much to improve the quality of life in this region. Another serious concern I have has to do with the impact the construction is going to have on the tourist dollars and the financial well being of this community. The loss of 80% of the campsites in the River Pond basin, combined with reduced event facilities, combined with restricted access to the park could well result in Tuttle Creek Park and the

Manhattan area no longer being considered a Recreational Destination. Businesses throughout the area will be affected. My business, Kansas River Outfitters, is part of this Recreational Destination as are hotels, grocery stores, and gas stations jut to name a few. In business, the difference between success and failure is often simply a matter of location. Like most other small business owners, Kathy and I have committed everything to this business because it is within a Recreational Destination. We have worked hard to promote this area, as a Recreational Destination knowing that to do so would increase our own chances of success. If this project proceeds as currently proposed, all we have worked for will be gone. Whether or not interest in this park is eventually restored to a level similar to that which exists today will not matter to Kathy and I, because long before that time our business will have been washed away; right along with so many other of our neighbors who depend on recreational dollars for our livelihood. Our business, like so many other local businesses, has made positive contributions to our community. Kansas River Outfitters has hosted many instructional programs such as the Shawnee County Parks and Recreational Summer Camp Program, the AARP Kansas Canoe Experience, Boy's and Girl's Scout Paddling Events, Spring and Fall Park Festivals, the Ft. Riley BOSS Program for Single Troops, events for the YMCA and Manhattan Job Corps, Manhattan Disc Golf Course Tournaments, AmeriCorps Kids Programs, events for the Optimists Club, as well as Church and School Events and Programs. All of this in addition to the services we have provided to everyday local families who were just seeking a quiet afternoon paddling the River Pond; away from the Video Games and TV. But our opportunities to provide this level of service to the community will no longer exist if the number of park visitors drops as we expect under the conditions created under the current Army Corp of Engineer Plan. For although we are a river outfitter business, a substantial portion of our business is directly related to people who use our services not on the river, but within the park. For the sake of the community, I believe the Corp of Engineers has an obligation and duty to maintain a recreational facility equal to that which now exists in the River Pond basin during the entire course of the dam restoration project. If the maintenance of such a recreational facility within the River Pond basin is impossible, then I believe the C.O.E. has a moral obligation to this community to establish an equivalent recreational site somewhere along the shores of the Tuttle Creek Reservoir. I also believe it fair for the Corp to be financially responsible for the relocation of my business establishment to that recreational site. Charles P. Burgess, Owner Kansas River Outfitters, by letter.

R: Comments noted. In efforts to develop measures that would offset potential impacts, Kansas River Outfitters has been given numerous opportunities to present the nature and extent of the damages that would be expected. The Corps of Engineers and the Kansas Department of Wildlife and Parks have agreed upon measures to offset impacts to the River Pond area that will offset impacts during construction and significantly increase the attractiveness and earning potential of the area in the long run. The Environmental Impact Statement presents that the business opportunities in the River Pond area are likely to increase. The agreed upon additions being made to offset impacts

further supports that statement. It should also be noted that the Corps of Engineers, by specific contract language, has no direct obligation to offset impacts to leasees or concessionaires.

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C: I believe that the Tuttle Creek Dam must be made safe by whatever means necessary to protect the downstream Community as well as minimize the construction impact. The Corps also has a responsibility to maintain a similar level of recreational facilities to this Community as is now available in the River Pond. With the repairs to Tuttle Creek Dam, the River Pond will be a former shadow of itself, if it survives at all. When construction begins in the River Pond, the effects thereof will reduce the population of Eagles and other wildlife, affect water quality downstream, reduce air quality, encounter increased noise levels from drilling rigs and heavy equipment 24/7, destroy 80% of the camp sites, reduce picnic locations, eliminate the Disc Golf Course and Player traffic, relocation of the Park Office, limit access, reduce fishing and Swim Beach use and reduce Security and services for 7-10 years. Without a viable location allowing us to offer a similar standard of service to the community as we have in the past, Kansas River Outfitters won't survive. Destruction of this beautiful River Pond Area and all it's resources is in the horizon and Kansas River Outfitters will be washed down the river with it. Tyler Fritz by E-mail.

R: Kansas River Outfitters has been given numerous opportunities to present the nature and extent of the damages that they would expect to see in an effort to develop measures that would offset these impacts. The Corps of Engineers and the Kansas Department of Wildlife and Parks have agreed upon measures to offset impacts to the River Pond area that will offset impacts during construction and significantly increase the attractiveness and earning potential of the area in the long run. It should also be noted that the Corps of Engineers, by contract, has no direct obligations to offset impacts to leasees or concessionaires.

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C: Don't hamper tourism - boating & fishing. Remember - We have Country Stampede, we don't want to lose it!! Response to Project Impact Survey by mail.

R: Comment noted. The preferred alternative is considered to have the least impacts to tourism.

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C: The Riley County Radio Control Flyers wish to express our support for the Tuttle Creek Dam Safety Assurance Program. Although the risk of dam failure is small, the potential consequences to the community are too high to ignore. In 1990 club members started the task of carving a flying field out of 4.4 barren acres on the west side of the spillway. Members spent countless hours and dollars creating the current flying site in partnership with the Corps. After reading the Tuttle Creek Dam Safety Project Environmental Impact Statement it is crystal clear the Radio Controlled Flying Field will be significantly impacted by the current projected plans. A worst case scenario is the permanent loss of the field or at the very least the entrance to they flying site will have to be significantly modified. We understand that during the construction period the road that connects K-13 and runs along the base of the dam will be closed to the public thereby eliminating the current acce4ss to our flying field. We also understand that prior to construction a new road will connect Dyer Road to the River Pond State Park area crossing the spillway outlet. We would like the Corps to seriously consider building a small service road along the west side of the spillway extending north from the new River Pond State Park road to our current flying site. This dead end "service road" would carry very little traffic, could be clearly marked for the Radio Controlled Flying Club, and should not interfere with the original construction road. This proposal would offset and minimize the projects impact to the R/C Flying Field and members. For the record, the fields usage is almost exclusively after 5pm on weekdays, during the weekends and holidays. These times should not conflict with the normal construction schedules. We have enjoyed our long standing relationship with the Corps and appreciate your consideration and any assistance in this matter. Bill Fortney, President of the Riley County Flyers and Gary Neihaus, Secretary of the Riley County Flyers by letter.

R: The documents have been revised to maintain access to the current field location.

6145

C: Clearance of the project should be granted. Ronald Hammerschmidt, Kansas Department of Health & Environment, by letter.

R: Comment Noted.

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C: The Manhattan Area Chamber of Commerce developed a formal position with-respect-to the Dam Safety Assurance Program for Tuttle Creek Reservoir in November 2001. Specifically, our position is as follows: "Flood protection and recreation are the primary functions of Tuttle Creek Dam that must be preserved. The Manhattan Area Chamber of Commerce is opposed to removal of Tuttle Creek Dam, management of the floodplain that would prohibit development below the dam, or restricting lake levels to address seismic dam safety. If significant improvements are needed to enhance safety, we ask that they be performed in a timely manner with minimal reduction of the lake level in order to reduce the negative financial impact on real estate and tourism." Lyle A. Butler, President/CEO Manhattan Area Chamber of Commerce by letter.

R: Comment Noted.

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C: Secondly, we feel the proposed road closing below the dam, and the possible ingress and egress solutions identified to date can have a significant impact to local businesses and events. We urge you to work with all parties affected by this situation to ensure the final solution mitigates as many negative impacts as possible. Lyle A. Butler, President/CEO Manhattan Area Chamber of Commerce by letter.

R: Comment Noted. The Corps of Engineers has spent significant effort coordinating with local businesses and events. The preferred alternative and the proposed efforts to offset impacts are believed to have the least impact, and in many cases, may enhance local businesses.

6150

C: In terms of immediate and direct benefit to the Manhattan area economy, the U.S.A.C.E. should be required to utilize the local workforce and local resources to implement the project to the extent practicable. Response to Project Impact Survey by E-mail.

R: While the Corps of Engineers cannot mandate the use of local workforce and resources, financial considerations in obtaining products and services at the least cost typically dictate the use of local labor and resources to the maximum extent possible.

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C: The preferred alternative won't have a negative impact on me or my family as best as I can tell Bob Stamey, Board Member, Riley County Chapter, American Red Cross, Project Impact Survey response by E-mail.

R: Comment Noted.

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C: Possible implications (Negative community impacts) to the country stampede. Any concerns they have need to be addressed by the Corps long before the Stampede begins its renewal process for location. Ken Hays, Project Impact Survey response by E-mail.

R: Comment Noted. The Corps of Engineers has committed to accommodating the Country Stampede at its current location to the maximum extent possible.

6154

C: It is hard to say at this point (if the preferred alternative will have any negative community impacts) since I am not absolutely sure what the impacts will be on the Tuttle Creek State Park area. If access to this area is restricted in some way, it could have a negative impact on the community. I would like to reserve judgement on this until I hear more about the impacts at the May 2 meeting. Monty Wedel, Project Impact Survey response by E-mail.

R: Comment Noted. Access to Tuttle Creek State Park is anticipated to be enhanced during and after this project.

6155

C: From a fire service standpoint, the only concern I have is with reduced or eliminated vehicular access on K-13 hwy across the dam during all or part of the project. This concern can be worked around, though. There may be other impacts to the community in other areas, but this would be the area that I/we have interest in. Eric Ward, Chief, Blue Township Fire-Rescue, Project Impact Survey response by E-mail.

R: Comment Noted. Access will be maintained across the dam for essentially the entire project. Any lane closures or changes in access will be coordinated with emergency services.

6156

C: The preferred alternative will have negative impacts to Recreation maybe! But, the revenue created by the jobs which will take place from the stabilization will be of a tremendous boost to the community. Seven to ten years is a considerable amount of time! Ron Dickey response to Project Impact Survey by E-mail.

R: Comment Noted.

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C: In the short-term, or until the project has been completed, it would seem that the preferred alternative would have zero impact in terms of addressing the needs of the community. In the long-term, once the project has been completed, the preferred alternative should satisfy the objective of mitigating the hazards posed by a hypothetical earthquake, thereby offering long-term protectiveness to the community. However, it is unclear as to the degree of long-term protectiveness such mitigation would actually achieve. Please quantify the degree of long-term protectiveness anticipated to be achieved by the preferred alternative. Response to Project Impact Survey by E-mail.

R: Comment Noted. The preferred alternative will be designed based on current technology to permanently prevent dam failure due to the largest possible earthquake believed to be possible in the area.

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C: The preferred alternative would have negative impact on the community if unsuccessfully implemented or if the solution was not permanent. What measures will be taken to ensure successful project implementation (e.g., quality control during stabilization of foundation soils)? What degree of permanence will be achieved by the preferred alternative? The concern is that the preferred alternative not be a "band-aid" solution resulting in the hazards having to be readdressed in future years. Response to Project Impact Survey by E-mail.

R: Comment Noted. The preferred alternative will be designed based on current technology to permanently prevent dam failure due to the largest possible earthquake believed to be possible in the area.

6160

C: Aesthetic and travel to work and home for those who live across the dam (will be negative community impacts). I consider this a health and safety issue for much of Manhattan, that needs to proceed at once. Frank Gibbs, Project Impact Survey response by E-mail.

R: Comment Noted.

6161

C: I believe the preferred alternative has no effect on the community, except that it may create jobs. As far as needs, the preferred alternative is best suited for those into the areas lake recreation. Jeff Hancock, Project Impact Survey Response by E-mail.

R: Comment Noted.

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C: None (negative impacts of the preferred alternative) that I can think of, unless we end up paying some of the cost. Jeff Hancock, Project Impact Survey Response by E-mail.

R: Comment Noted.

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C: Without drawdown, (the preferred alternative) should have no negative effect, except traffic. Olivia Huddleston for Flint Hills Trail Association, Kansas Trails Council, Inc., Project Impact Response by E-mail.

R: Comment Noted.

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C: It (the preferred alternative) will disrupt the many activities that take place in the spillway and river pond areas for several years. In addition to the loss of a facility, there will be an associated economic loss to the community. Mark Taussig, Project Impact Survey response by E-mail.

R: Comment Noted. Replacement facilities and other efforts to offset impacts to the River Pond have been agreed to with Kansas Department of Wildlife and parks to prevent the loss of a facility.

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C: The Corps admits that noise will be a factor. Road access below the dam will be somewhat difficult. Project Impact Survey response by mail.

R: Comment Noted.

6167

C: What would be the impact on the River Pond and Outlet Park area, both short term and long term. Is it going to be eradicated, drastically modified, closed, or lessened in size? Mike Kerns Verbal Comment at 02 May 2002 Community Meeting.

R: Outlet Park and the stilling basin area (the tubes) will not be impacted. The day use area immediately east of the tubes will be physically impacted by construction and will be replaced in an un-impacted area. The River Pond area will be impacted due to road alignment changes and noise from diesel engines and heavy equipment movement. We do intend to close the toe road below the dam to avoid conflicts between construction and recreation traffic, construct a new entrance to River Pond State Park from Dyer road on the east. Other impacts to the park will be offset through the improvement of existing facilities farthest from the dam and construction of new facilities on the south side of the River Pond. The complete plan for offsetting impacts to River Pond State Park has been coordinated with Kansas Wildlife and Parks and is presented in detail in the report.

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C: We understand that camping facilities in Tuttle Cove are being proposed to offset impacts to those in River Pond. I am concerned that those facilities will flood out and I thought that up on top of the spillway area would be a better area since it would never flood and there is water and electricity in that area already. We all know that the Tuttle Cove area floods. Alvin King Verbal Comment at 02 May 2002 Community Meeting.

R: The intent of offsetting impacts to camping facilities was to provide the public with the same level of service within the same general area. The complete plan for offsetting impacts to River Pond State Park has been coordinated with Kansas Wildlife and Parks and is presented in detail in the report. The facilities to be constructed in Tuttle Cove are above high pool levels. The final plan does not include changes to the facilities in Spillway Park.

6170

C: What would be the impact to water levels in the River Pond? Jenny Hale, K-State Athletics, Verbal Comment at 02 May 2002 Community Meeting.

R: River Pond levels are primarily controlled by discharges from the tubes. During extreme drought conditions, if no discharges are made from the lake, the level in the River Pond could drop to the water level in the river. However, in extreme drought conditions, it is likely that water quality or drinking water releases will be made from the lake. These releases would keep the River Pond level near normal.

6171

C: K-State uses the reservoir every day for rowing and we are concerned about safety along the face of the dam. Would there be an area along the face of the dam in which we could not row. Jenny Hale, K-State Athletics, Verbal Comment at 02 May 2002 Community Meeting.

R: Safety of the rowing crews is not expected to be an issue during construction. If silt curtains are installed in the lake to minimize silt movement from the dam, it may be necessary to move the rowing course slightly farther from the dam than it is now. It is unlikely that the course would be moved out of the wind footprint of the dam. The course would be expected to remain in a sheltered area during construction. We will consider the need for a safe zone for all boat traffic along the face of the dam during the design process.

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C: Would the work be 5 days a week or 7 days a week? Jenny Hale, K-State Athletics, Verbal Comment at 02 May 2002 Community Meeting.

R: The intent is to leave the exact working days open for consideration during construction.

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C: With all of the work on the dam, with a southerly breeze, dust from the work will be traveling directly over the rowing course. Charlie Burgess, Kansas River Outfitters, Verbal Comment at 02 May 2002 Community Meeting.

R: The Corps of Engineers has relatively strict dust control regulations that are applied to all projects, and would be especially applicable to earth moving operations on this project. Additionally, the nature of the ground modification operations is that they are “wet” operations involving large quantities of water, thus minimizing dust.

6175

C: What about the diesel fumes from six to 12 diesel units running all of the time? Charlie Burgess, Kansas River Outfitters, Verbal Comment at 02 May 2002 Community Meeting.

R: There will be diesel exhaust from equipment operating on the dam. Impacts from this exhaust are expected to be minimal due to the distance between the construction operation and recreational users.

6176

C: What is going to stop turbidity from moving right on down river to the River Pond and beyond and how is that going to affect the fish as all of the pesticides that this dam is holding once you get in there and start stirring it up? How are you going to contain that and keep it from moving downstream? The dam is a huge filter that, over time, catches and holds pesticides and anything else that comes down river in the silt. Now once you get in there and start stirring it up, where is that going to go and how are you going to contain it. Charlie Burgess, Kansas River Outfitters, Verbal Comment at 02 May 2002 Community Meeting.

R: This project does not involve moving or disturbing silt within the reservoir. The ground modification efforts treat only the native soil beneath the dam. Any material placed or moved on the face of the dam will be rock or excess grout from the operations. However, for reference, the United States Geological Survey has sampled and performed chemical tests on sediments from Tuttle Creek lake. That information is available as report WRIR 02-4048, Juracek and Mau “Sediment Deposition and Occurrence of Selected Nutrients and Other Chemical Constituents in Bottom Sediment, Tuttle Creek Lake, Northeast Kansas”.

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C: Could you address the increased pH levels from the injection of the grout?
Charlie Burgess, Kansas River Outfitters, Verbal Comment at 02 May 2002
Community Meeting.

R: Uncured cement has a high pH. When mixed with soil beneath the groundwater. There is a potential to see an increased pH in the immediate work area and we would expect to monitor for pH levels under a National Pollutant Discharge Permit that will be obtained from the Kansas Department of Health and the Environment specifically for this project prior to construction. Information from recent visits to a major jet grouting project in an environmentally sensitive area in Oregon indicates that pH changes are not noted in a stream within 200 feet of the work.

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C: With all due respect to the Stampede, and they bring sizeable income into the Manhattan community area, for that I am sure there are a lot of people that see benefit from that, the reality of it is that Tuttle Creek River Pond as well as the upper side of the lake brought over a half a million people into the park. That is a substantial revenue base. When this project begins, it is going to reduce that park and diversify that park so that it will not be able to produce as it has in the past. In my understanding of it, it is going to be very limited. Now the other side of that is that the revenue that comes to Tuttle Creek state park goes into a slush fund that goes to all Kansas State Parks. When this River Pond event happens, that is going to be felt throughout the state in the Kansas Park system. I would like to know if you have a plan that is going to equal the production of Tuttle Creek State Park and River Pond to help support the revenue dollars and the economic base that is produced in Manhattan and tot the rest of the Kansas Parks. Charlie Burgess, Kansas River Outfitters, Verbal Comment at 02 May 2002 Community Meeting.

R: The Corps has certain limitations within which it must consider offsetting impacts resulting from this project. We have coordinated with Kansas Wildlife and Parks and have arrived at a mutually agreeable solution to offset impacts to the River Pond State Park. The details of this plan are included in the final report.

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C: I want to commend you because I know you had several discussions with the officials with the Country Stampede. Although we are concerned from a tourism standpoint with a lot of things regarding this project, that is one that we certainly do have some specific concerns about. Can you address how that event would be impacted and would you expect it to continue in its current location? Becky Blake, Convention and Visitors Bureau and Chamber of Commerce, Verbal Comment at 02 May 2002 Community Meeting.

R: The Corps has made a commitment that the short time frame required by the Country Stampede will be accommodated by the dam safety project. The exact nature of those accommodations is to be developed and coordinated during design and construction.

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C: Is there any truth to the rumor that the toe road will be closed permanently? Do you envision permanently restricting access off of the highway? Becky Blake, Convention and Visitors Bureau and Chamber of Commerce, Verbal Comment at 02 May 2002 Community Meeting.

R: The existing toe road will be closed to prevent the mixing of construction and recreation traffic. A new traffic flow pattern through River Pond State Park will be established. We do not intend to permanently restrict access off of the highway.

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C: Once construction starts on the dam, is it a 24 hour operation? Keith Eyestone, Big Dawg Marina, Verbal Comment at 02 May 2002 Community Meeting.

R: Normal operations are expected to be daylight to dusk operations. However, there may be situations such as rapidly rising lake levels, where 24 hour operations may be necessary.

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C: The equipment that is coming in there will be large equipment and will be noisy. Have you assessed how far that noise is going to travel and have you used a formula to determine how many people will be disturbed by the noise? But you anticipate that noise will impact downstream users and upstream residences. Will there be some reverberation from the equipment? You expect a dramatic decrease in the usage of the River Pond area don't you? You will tell us when you come up with a plan for the River Pond area. Mike Kerns, Verbal Comment at 02 May 2002 Community Meeting.

R: We have not used mathematical modeling to evaluate noise levels since seasons; wind conditions, reservoir levels and other factors would impact the levels significantly. Noise is identified as an impact to the River Pond area usage and upstream residents will be able to hear the equipment. Significant vibration from the equipment is not anticipated since impact and vibratory construction equipment is not anticipated to be used. We are developing a plan to offset impacts to the River Pond area with Kansas Wildlife and Parks and will present that plan in the Final Environmental Impact Statement.

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C: Have you assessed the increase in truck traffic that is going to be associated with this project for Manhattan and Riley County? Mike Kerns, Verbal Comment at 02 May 2002 Community Meeting.

R: We have not performed detailed traffic counts. We will do road condition surveys before and after the project and we will work with the State and counties to take road conditions and repairs into consideration.

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C: What would it take you to stop this project? What environmental impact to the community would it take to outweigh any benefit? Mike Kerns, Verbal Comment at 02 May 2002 Community Meeting.

R: .The preferred alternative was selected largely due to its limited impacts to the community. If the community indicates to an overwhelming desire not to address the concerns for the dam, that situation would be considered. However, any change or halting of these efforts would also need to address the risks to the downstream community and ensure community safety. Corps of Engineers regulations require that dams be safe as a baseline.

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PROPERTY ISSUES

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C: We are here to show our support for the dam safety program. Our concern is for loss of life and improved property and how that affects our response and recovery program. Ken Sessa, Federal Emergency Management Agency, Verbal Comment at 02 May 2002 Community Meeting.

R: Comment noted.

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TAINTER GATES

C: Why are the gates called "Tainter gates"? Comment Card at 02 May 2002 Community Meeting.

R: Radial arm gates such as those at the Tuttle Creek spillway are referred to as Tainter gates after the inventor of this type of gate, Jeremiah Burnham Tainter.

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HYDROLOGIC

C: This wall will interfere with the beauty of the lake. Reconsider this wall. See attached article. This sucks. Natural beauty must remain! Project Impact Survey by mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blockage of the view from the Highway 13.

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C: Please discuss why the 4-ft barrier cannot be placed on the south side of the road across the dam as proposed in the Mercury article or in the middle of the road? Comment Card at 02 May 2002 Community Meeting.

R: Placement of the barrier on the downstream side of the road is of concern to those that appreciate the view of River Pond State Park provided from the top of the dam. From a dam safety standpoint, placement of the barrier on the downstream side of the road subjects the roadway to wave action that could break up the asphalt and start erosion that would undermine the barrier and lead to failure of the dam.

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C: In general, we find your recommended position described during the public meeting on May 2, 2002 to be consistent with our formal position. However, we take specific issue with several items within your position. First, we disagree with the placement of barriers on the road going across the dam. We find the possibility of their use extremely remote, and such barriers on a day-to-day basis would ruin one of the best views in our area for local residents and visitors to our community. Lyle A. Butler, President/CEO Manhattan Area Chamber of Commerce by letter.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: Mr. Seaton has very neatly described one part of the proposal to save property downstream from Tuttle Creek if all worst case scenarios occur at once. He was on in last night's Manhattan Mercury about the idea of putting a forty two inch wall on top of the dam. Even if such a proposal seemed required by actual threat, the wall idea would still provoke chuckles. But the proposal doesn't seem even remotely necessary. Only the price tag--is it \$192 million?--seems real. How much would it cost the Corps to buy flood insurance for properties in the Blue River's post-Tuttle flood plain? And how many years until the lake will supposedly be silted in? I know the Corps needs practical experience, but the projects associated with vast, unimaginable floods AND big, big earthquakes don't seem practical. They seem self-satiric. G.W. Clift by E-mail.

R: Comment Noted. An earthquake and major flooding are considered to be separate events for all of the measures and alternatives being discussed. Flood and earthquake issues discussed in the report are do not occur simultaneously. Efforts are needed to address both concerns and it is prudent to do so under a single proposal as they are both funded from the same funding source.

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C: I took a drive the other day across the dam, enjoying the view of Tuttle Creek Lake off to the north. Somehow, looking at a big expanse of water (even a muddy one) is awfully relaxing, particularly on a warm spring day. And then a thought intruded - in a few years, nobody will be able to enjoy that view. Lost in a lot of the discussion about the future of Tuttle Creek Lake is one of the silliest proposals I have ever heard. The idea is to build a three-and-a-half-foot-tall wall along the lake side of the road over the dam. Blocking the view of the lake is not why they want to build the wall, but that's exactly what will happen. I have an alternative idea I hope you'll help me promote. More on that in a minute. Let me see if I can walk through the, um, logic behind the wall proposal. In addition to looking at what would happen to the dam in the event of an earthquake (which seems like overkill, too, but that's another story) the U.S. Army Corps of Engineers is examining how the dam would hold up under extreme conditions. So the Corps tried to come up with a model of the worst possible flood that could happen here. Basically, that meant drumming up computer-simulated conditions assuming a flood as big as the 1993 flood and the 1951 flood HAPPENING AT THE SAME TIME. Bill Empson, the guy at the Corps office in Kansas City who's running this whole dam-evaluation project, refers to that scenario as "Noah's flood." He also freely acknowledges that the likelihood of such a flood is "so small that you couldn't even put a percentage on it." But, following the computer model down this loopy path, it turns out that the lake would be high enough that wind-driven waves would splash over the top of the dam. Not that the water level would run over the top of the dam, mind you, just that waves would splash over. Ahem. Let me rest a moment to recover from the strain on my credulity. To deal with this, the Corps proposes the wall we're talking about. It would be high enough to stop the waves from splashing over. It would also simply ruin the view of the lake for thousands of motorists and remove one of the small pleasant

aspects of living here. My brother, tongue planted firmly in cheek, suggested a couple of ideas we may also want to consider: *In case there's a flood of that magnitude, we should require that all buildings in Manhattan be built with styrofoam floats. *Better yet, we should prepare now by building an exact replica of Manhattan elsewhere, so that when the big flood comes, we can simply abandon the one we've got without much of a lifestyle interruption. *How about building an enormous fan on the other side of the dam to blow the waves the other direction? *We may need to immediately institute a city program to issue scuba gear and training to every resident in Manhattan, and perhaps to require that all cars be equipped with outboard motors. Now, seriously, I realize that safety is important, and if Noah's flood does hit, maybe we'll wish we had done something. On the other hand, it seems like waves splashing over the top of the dam at that point would be the least of our worries. The wall, it seems to me, is totally unnecessary. But even if we concede to the engineers that this sort of thing could happen, and that it's worth worrying about, I have a rather simple proposal: Move the wall to the other side of the road. That would protect the other side of the dam from the erosion that the waves could cause, which is the big concern. Yes, it would mean that the waves could splash up on the road, but who in their right mind would want to drive on the road in that situation anyway? The thing is, it would preserve a beautiful view of the lake. Now, in the grand scheme of things, this may not be the biggest issue. On the larger issues - such as the way in which the entire dam repair project is to be carried out - I think the Corps deserves a lot of credit for listening to the public. But if we can save the view of the lake, shouldn't we? Maybe you have other ideas. Perhaps the wall could be in the middle of road, acting as a traffic-control device. Maybe we could buy some barriers and stick them in a closet until we get a sense that Noah's flood is imminent. I'm sure there are other ideas. What you need to do is let the Corps know that its wall plan is silly. Go to the public forum on this subject at 7 p.m. Thursday at the Holidome. Or submit written comments on this issue to the Corps, before the plan is finalized. To do that, you can send e-mail to tcdam.nwk@usace.army.mil, or regular mail to: William Empson Project Manager EC-GD U.S. Army Corps of Engineers 601 E. 12th St. Kansas City, MO 64106 You need to do this in the next couple of weeks, or else the train will be too far down the tracks to do anything about it. Ned Seaton; Manhattan Mercury Editorial.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: I attended the community meeting in Manhattan last night. I thought the presentation was very informative, and am very happy with your recommendation. As a homeowner in the Northview/Dix addition, I applaud your intention to address the community safety issue. I was dismayed after last year's meeting at the number of people who said "Do nothing." To me, the recreation and other issues are important, but only after safety to life and property are assured. Debora Madsen by E-mail.

R: Comment Noted.

6204

C: We cross the Tuttle Creek Dam several times a week and always anticipate the changing views on the lake-ducks, geese, sailboats, fishermen, crew racing and birds sitting ice patches. We think placing a 3-½ foot barrier at the top of the dam is absolutely ridiculous. This would cut off the view of the lake to thousands who cross daily as well as visiting tourists who enjoy the of the lake. There are a couple of stories you should refer to before completing designs for such an irrational project (1) The Three Sillies (Grimm's Fairy Tales) (2) The Bible-Genesis 9:11 (Never again shall there be a flood to destroy the earth) Donald and Gwen Kropf by letter.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: We don't need the Jersey Barriers. Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted.

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C: We share Ned Seaton's concern about the concrete barricade along the top of the dam. Is that necessary? Could barricade be on south side of highway? Comment Card at 02 May 2002 Community Meeting.

R: Placement of the barrier on the downstream side of the road is of concern to those that appreciate the view of River Pond State Park provided from the top of the dam. From a dam safety standpoint, placement of the barrier on the downstream side of the road subjects the roadway to wave action that could break up the asphalt and start erosion that would undermine the barrier and lead to failure of the dam.

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C: Regarding the wave barriers - how much rain would it take & what length of time to create a flood scenario that you have described requiring wave barriers. It seems extremely unlikely & therefore unnecessary. Linda Shostak by Comment Card at 02 May 2002 Community Meeting.

R: The drainage basin of Tuttle Creek Lake is roughly the size of the state of Maryland. The modeling of lake levels in a drainage basin the size of Tuttle Creek's involves the consideration of many complex parameters including rainfall, runoff, rainfall distribution, runoff timing and losses among others. However, the general description of the rainfall modeled is 23.6 inches of rain over a three-day period.

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C: I am writing to oppose the proposed plan of building a WALL (?!?!?) on the Tuttle Creek Dam! The idea is totally preposterous! I personally think the whole re-structuring of the dam is and will be a total waste of money and time, but to add a wall to keep out the splashing of the waves in the less than miniscule chance of having this so-called 'Noah's Flood' is idiotic to say the least! Some government department, somewhere, must be feeling threatened as to losing their grants and or JOBS, so instead are spending hundreds of thousands of our tax money to come up with these totally irrelevant surveys and projects, which will then cost us MILLIONS of dollars! Is there not anyone who has the guts to say, 'Look, this is ridiculous.' I would applaud him/her as would thousands of other concerned and common sense thinking people. Kim Thornburrow by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: I watched as they built Tuttle Creek Dam but I don't want to watch as they destroy Tuttle Creek Dam. If you build the wall that blocks the view of the lake, you will be destroying the last and only good thing that remains of the Dam. No longer do you see many boats, campers, or swimmers taking advantage of the lake. You do see, however, the wild life and beautiful vista of water and trees as you drive across the dam. Please do not take that away from us. Fix what can be fixed without the wall that will block the view. If the wall has to go up, I do not want it fixed. Spend the money dredging instead. Elise Butcher by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: When I was a kid, some people referred to Tuttle Creek Dam as "big dam foolishness," but in the years since its construction it has served its purpose well and has become a beautiful addition to the valley. I realize that you all are trying to ensure that the dam remains whole throughout any exigency, but I urge you to try to retain as much of its scenic beauty as possible. Building a wall along the lake side of the road atop the dam, that precludes people from enjoying the view of the lake does not seem logical--when there are other ways to accomplish potential wave retention that won't obstruct the view. Please find and use a solution that preserves the view of the lake from the road that runs across the dam. That way, perhaps this time around people won't be talking about "big dam foolishness" that diminishes its beauty while making it structurally sound. They'll be extolling the Corps for having retained the dam's beauty and increased its functionality at the same time... Bud Wareham by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

6214

C: I do not like the current proposal which has been published regarding the reinforcement of Tuttle Creek Dam. I also do not like the proposal to put a wall along the north face of the dam along the roadway. The following are my reasons: 1. When completed in 1962, the general public believed that this dam would last an extremely long time. Currently, 40 years into its lifespan, there are extensive mud flats in what once were the containment areas of the lake. These flats are projected to continue to grow, and eventually overtake the majority of the lake's current water surface. If this has occurred in 40 years, then why in the world should there be \$175 million spent to reinforce a dam which eventually will hold back perhaps a puddle of water and a huge swamp? Has any consideration at all been given to this situation? 2. If the "Noah's Flood" scenario comes into reality, the water contained in Tuttle will be spilling over the top of the flood gates LONG before it would reach the top of the dam and the road surface. Do you remember 1993? I do, and I witnessed the Corp having to open the spillway gates to keep from losing them to the force of the water they were attempting to hold back. The gates were being topped by the water at that point, and although the road was closed during the height of the flooding at that time, I do not believe the water came near the top of the structure. If it does, water splashing across will be the least of your worries. I feel that the Corps' most important job right now is to assess the actual life of this project. If 40 years has marked the one-third or half-way point in the lifespan of this containment area, then the most important need at this time is to find a way to stop the process of sediment filling from the north end down, or the above prediction will come true. What happens if we have even the 1993 level flood today? Where will all the water go, since mud has filled a large area of what was water containment area at that time. What good will the "scenic view" be to the homes along the lake if either of these happen? During this 40 year period, what has been the ACTUAL activity recorded on the Waubesaunsee fault? Any at all? Worst case scenario is a lovely projection when it will earn you the right to spend \$200 million of my tax dollars!

I believe that this project, which will of course run well over budget if it is actually started (a project which is forecast to last "a few years" will run significantly over budget simply due to inflation if nothing else...) would be a complete waste of taxpayer money, a tremendous disadvantage to those who currently use the River Pond recreation areas, and a serious misidentification of the underlying need--the assessment of the actual health of the entire project (not just the dam, which is only one part of the Tuttle Creek Lake project) and then, after careful assessment, a more realistic and less costly approach. I do not wish to inflict upon Manhattan and downstream communities the result of a do-nothing approach if in fact there is credible cause to believe there would be an earthquake of the magnitude necessary to liquefy the sand below the dam. But I am convinced that history would make that possibility unlikely at best. Let's fix what is already broken before we borrow problems from a far fetched might be scenario. Donna Baer by E-mail

R: 1. As documented in the reports, siltation of the lake was considered in the original design of the project. Tuttle Creek Dam will continue to provide flood protection and other project benefits for many decades to come.

2. In extreme flood situations, the spillway gates are designed to be opened as they were in 1993. With sufficient inflow to the lake, the lake level can rise even with the spillway gates open. In 1993, the spillway gates were opening in accordance with the published guidelines for lake level management and dam safety. There was not a threat to the integrity of the gates or the spillway.

Although downstream flooding would be occurring with the spillway gates open, waves breaking over the dam could cause failure of the dam which would increase flooding economic damages and potential loss of life downstream well past Topeka and Kansas City.

To date, siltation of the lake has only minimally impacted the flood control storage in Tuttle Creek lake.

A study of small earthquakes that cannot be felt indicates numerous earthquakes over roughly a 10-year period. In the spring of 2001, a small earthquake was felt near Wichita on the same fault system. These events indicate continued activity on the fault.

The project cost is identified as 2001 cost level and "inflation" is not included in the calculation

Comments noted.

6216

C: Please do not construct the wave wall. I could write you a thousand reasons why, but I do not have the time to list them all. The wall is the most ridiculous idea I've heard in a while. All I'm asking is for those involved to take a coffee break and actually think about what they are proposing. Use a little common sense. Computer models are good for testing human ideas, but to rely on them to project reality without the aid of common sense would be a huge mistake. If the odds of having a flood the magnitude equal to the 51 and 93 flood combined are so small that you couldn't even put a percentage to it, then why bother. If your response is that you are trying to protect the safety of the populations affected by the dam, don't bother, we don't care whether or not water is able to splash across the road. We don't care if the road gets damaged. We don't care about any erosion that might occur on the south side of the dam. Trust me, if we have a 1 one in a trillion year flood like your computer models predict, then we have bigger fish to fry than worrying about wind blown waves crossing the road. Michael Carson by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

6217

C: I live in Westmoreland Kansas and go to Manhattan on a regular basis, and my husband works in Manhattan. We are very concerned about your idea of putting a wall on the water side of the dam. When you decided to install the dam over the protests of the people you displaced against their wishes there seemed no reason. I'm still not sure that your reasons were sound when we drive across the Randolph bridge and see nothing but dirt, it used to be pretty with water winding down. Now you want to take away our view of the valley again. In my opinion if the water is high enough to be lapping on top of the dam your concern should be with evacuating Manhattan and areas down stream as that is way too much to expect the dam to hold. Thank you for considering my opinions. Sandi Fowler by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: A wall at the top of the dam that obstructs the view is not a good idea. Let's think of a different way to accomplish its task, or skip it all together and take our chances. Kate Watson by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

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C: Please add my name to the list of people who are horrified about the proposal to impede the view one sees in driving across the dam at Tuttle Creek Lake. Ned Seaton's May 1 "Manhattan Mercury" column undoubtedly speaks for an overwhelming majority of residents of this entire area who would be both enraged and heartsick if the vista to the North, South, or ANY direction were obstructed. (The problem is that most people I know missed reading Ned Seaton's column and have no idea that the view from the top of the dam is jeopardized. It takes a long time for the word to spread about an issue and then for people to react. People can't believe the idea of a wall. They're saying, "No one would build a wall beside the road over the dam! That would be unbelievable! Wall talk is just some rumor.") (So if you get only a small number of complaints in the first few weeks, don't assume people don't care. You can be assured of a huge outcry if this ill-conceived proposal is implemented.) PLEASE, PLEASE, PLEASE don't construct some visual barrier that will make people denigrate the name of the U.S. Army Corps of Engineers every time they approach Tuttle Creek! Nancy Twiss by E-mail.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

6222

C: Has the dam moved? Rumors are that it has moved 1 foot? Is it strong enough to hold water lapping over the top of the dam? Comment Card at 02 May 2002 Community Meeting.

R: The dam has not moved. The proposed concrete traffic barriers are intended to prevent water lapping over the top of the dam to avoid potential failure of the dam.

6223

C: If and when the Project is complete, will the Elevation of the lake be changed? Comment Card at 02 May 2002 Community Meeting.

R: No.

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C: I want to piggy back on the editorial last night, you were disputing his comment that the barriers that you are going to put on the face of the dam only if we were dealt a flood of '51 plus a flood of '93. Is it correct that it takes both of those types of floods for those barriers to come into play? In 50 years, we have had two floods double the size of those, are we going to have a couple more in the next 50 years? I think you are really stretching the point that those are going to be required. I say you are never going to need those barriers. Its just a chance to spend more money and the tax payers should be really concerned about this program. Sheryl Crow, Verbal Comment at 02 May 2002 Community Meeting.

R: Comment Noted. The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

6226

C: What climatology or meteorologist experts have you involved in determination of the flooding? If the water goes through the gates with them completely open and the water up to the top of the dam, how much water will go through the spillway? Do you think that the barriers would still be necessary in that situation? Don Ritticher, Verbal Comment at 02 May 2002 Community Meeting.

R: The Corps uses data from the National Weather Service, an organization within the National Oceanic and Atmospheric Association for determination of rainfall events. If the gates are completely open, the spillway can discharge 600,000 cubic feet per second, which is enough to keep the lake from flowing over the top of the dam. The barriers would be needed in exactly that situation to prevent wave action from damaging to top of the dam and causing a potential release of the lake. In preventing the failure of the dam, the barriers prevent the overtopping of the levees in Topeka and Kansas City and prevent damage in those areas and further downstream.

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EARTHQUAKES/SEISMOLOGY

C: This is one of the biggest boon doggles the Corps has dreamed up yet. 3% probability in the next 100 years is nothing in the grand scheme of nature. I am not convinced. Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted.

6230

C: Leave the Dam alone. The risks of a major breach are minimal. The Corps of Engineers have already messed up our rivers, they don't seem effective in finding a happy medium between environment and progress. With them Environment always suffer. Laura Oesterhaus by E-mail.

R: Comment Noted. The preferred alternative has been selected to minimize environmental impacts.

6231

C: Why was there no concern about "liquefying sand" when the Dam was built? Comment Card at 02 May 2002 Community Meeting.

R: The dam was completed in 1963. The phenomenon of "liquefaction" or the loss of strength of sands due to shaking was not considered to be an issue for well-built dams until 1972 when the Lower San Fernando dam nearly failed in an earthquake.

6232

C: Can you give an explanation of the Operating Base Earthquake and how it relates to Tuttle Creek Dam? Comment Card at 02 May 2002 Community Meeting.

R: The Operating Basis Earthquake is a lower magnitude earthquake (4.9 magnitude) that the dam must be capable of withstanding with no damage and that non-critical portions of the dam (such as the bridge out to the intake tower) must be able to withstand. Above the Operating Basis Earthquake it is acceptable to experience minor damage to the dam and major damage to the non-critical structures since the dam would remain safe.

6233

C: What is the frequency of microseisms in the Tuttle Creek Area? Comment Card at 02 May 2002 Community Meeting.

R: Statistical frequency measurements of micro-earthquakes have not been performed since these events do not present a threat to the dam and are not directly related to damaging earthquake events.

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C: Where are the foci of the microseisms? Page Twiss, Verbal Comment at 02 May 2002 Community Meeting and Comment Card at 02 May 2002 Community Meeting.

R: Recorded micro-earthquakes generally trend along the fault system as shown in the presentation material and on project fact sheets.

6236

C: What are the causes of the microseisms? Comment Card at 02 May 2002 Community Meeting.

R: As with all earthquakes, micro-earthquakes are caused by the build up and release of strain along the fault system.

6237

C: What are the chances of a major earthquake occurring along the Humboldt fault or adjacent area? Comment Card at 02 May 2002 Community Meeting.

R: The probability of an earthquake greater than a 5.7 occurring along the Humboldt fault, close enough to impact Tuttle Creek Dam is statistically approximately three percent over 50 years. However, earthquake probabilities increase for every day that an earthquake does not happen. Therefore, it is impossible to put exact probabilities on a damaging earthquake that could impact Tuttle Creek Dam.

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C: In some seismically “active” areas, water is injected into the fault to alleviate friction and lessen the likelihood of a “major” quake. Couldn’t this be done with the Humboldt Fault? Would it be more or less expensive than this project? If time? Comment Card at 02 May 2002 Community Meeting.

R: Fault lubrication has been attempted in areas with faulting near the ground surface. Lubricating the Humboldt fault that exists at a depth of six miles below the ground surface is not considered practical.

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C: I thought that frequent small earthquakes released tension and hence, alleviated conditions that would lead to a larger, more catastrophic one? Are the Corps’ fears justified? (3% seems “high”) Comment Card at 02 May 2002 Community Meeting.

R: The occurrence of small earthquakes can release local stress but can also be indicators of the potential for larger earthquakes. The Corps of Engineers has enlisted the assistance of nationally and internationally recognized seismology experts, including the Kansas Geological Survey, for the evaluation of the seismic hazard in the area of Tuttle Creek Dam. These experts determined the probability of damaging earthquakes that could impact Tuttle Creek Dam.

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C: The possible earthquake damage to Tuttle Creek dam seems to be a "far fetched phenomenon", especially with only 60 plus years left in the life of the reservoir. Kansas is not exactly known for it's earthquakes! It seems that other threats such as a super flood; ice jams against the dam and spillway; and terror attacks are more likely. Manhattan may also have a greater likelihood of being flood within the dike than from the outside. I also question what will happen in the long term when the groundwater movement is blocked by a concrete curtain on it's never ending route down the Blue River Valley. This blockage will have a potential depletion effect on municipal, irrigation and domestic groundwater supply some distance down stream of the curtain. Overall, I view the project a waste of time, effort and money. Thanks for allowing comments; Gerald D. Hargadine by E-mail.

R: Comment noted. The Corps of Engineers has enlisted the assistance of nationally and internationally recognized seismology experts, including the Kansas Geological Survey, for the evaluation of the seismic hazard in the area of Tuttle Creek Dam. These experts determined the probability of damaging earthquakes that could impact Tuttle Creek Dam. Groundwater levels more than a few hundred feet downstream of the dam are largely controlled by river levels. Impacts on municipal, domestic, and irrigation wells are not expected.

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C: The preferred alternative probably addresses the needs of the community okay. Does the preferred alternative really solve the problem if a earthquake should occur? Maybe for a 5.7 but how about a 6.7? Gary Henton, Vice Chair, Riley County/Manhattan PROJECT IMPACT Steering Committee Project Impact Survey response by E-mail.

R: The preferred alternative will be designed to protect the integrity of the dam to the level of the largest earthquake that is believed to be possible in the region, which is a magnitude 6.6.

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C: The preferred alternative will have the negative impact on the community of Maybe creating a false sense of security that a major earthquake would not hurt the dam. Gary Henton, Vice Chair, Riley County/Manhattan PROJECT IMPACT Steering Committee Project Impact Survey response by E-mail.

R: The preferred alternative will be designed to protect the integrity of the dam to the level of the largest earthquake that is believed to be possible in the region.

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C: Has data collected on microseisms been considered in the plan? Microseisms indicate that pressure is being released. When things get critical are when there has been a long period when no pressure has been released? It is my understanding that there are weekly microseisms occurring in Manhattan? We don't have enough history to make an evaluation of earthquake risks. Page Twiss, Verbal Comment at 02 May 2002 Community Meeting.

R: Yes. The Corps of Engineers funded a study of microearthquakes by the Kansas Geological Survey. This data was considered in the development of the design earthquakes for evaluation of the dam.

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C: Have you considered approaching a major insurance company to get someone to calculate more precisely exactly how much chance there is for an earthquake large enough to destroy this dam in the next 50 years. You are dealing with numbers that are way up in the stratosphere. We have never, as far as anyone knows, had an earthquake in this area large enough to do the damage that you are worried about. Now that doesn't mean that we can't have one. In 1867 we had no way of measuring how big an earthquake was. I would like to see some better evidence at the base of this project that it really does need to be done. George Clark, Verbal Comment at 02 May 2002 Community Meeting.

R: Consultation from international experts regarding the earthquake potential of the Manhattan area was enlisted to ensure accurate characterization of the seismology of the area. These studies are extensively documented in reports prepared prior to and separate from the Evaluation Report/Environmental Impact Statement process. Additionally, the Kansas Geological Survey has gone on record before the Kansas State Special Committee on Energy, Natural Resources, and the Environment that the potential for these large earthquakes does exist.

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FUNDING

C: At the expo the statement was made that the Corps already had the money available. What happened to the money? Comment Card at 02 May 2002 Community Meeting.

R: Statements at the Manhattan Safe Home Expo were that the Corps of Engineers is not required to obtain specific Congressional authorization for Dam Safety Assurance Program projects and the Corps has money to start the project. More specifically, the Corps of Engineers is authorized a certain amount of money each year to start Dam Safety construction projects. After the first year, the funding must come from the overall Corps of Engineers budget. The ability to fund a project of this size from the Corps overall budget is dependent upon the Congressional authorization of the overall Corps budget. Funding to initiate the project remains in place.

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C: I think 196 million dollars is way too much to spend. Lets keep the water level way down for flood control seems to me that this will work. Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted. The alternative described is the "Restricted Lake Operation" presented in the report.

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C: Money might be better spent to dredge the upper part of the lake to prolong the life of the lake. Project Impact Survey response by mail.

R: Reducing the amount of sediment in the lake would not address seismic issues.

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C: I do not support the preferred alternative; 195 million reasons. No. Project Impact Survey response by mail.

R: Comment Noted.

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C: The Kansas Water Office appreciates the opportunity to comment on the Draft Evaluation Report and the Environmental Impact Statement.

The Kansas Water Office serves two roles from which our comments are based. First the Kansas Water Office is the state's water planning agency. As such, we are charged with coordinating water related projects and activities. Second, the Kansas Water Office operates the Water Assurance and Water Marketing programs. Both of these programs utilize water supply storage in federal reservoirs to serve the municipal and industrial needs of the citizens of Kansas.

In 1990, 1994, and 1996 the State of Kansas purchased water supply storage space in Tuttle Creek Lake. These contracts total 40.98 percent of Tuttle Creek Lake's conservation pool (50,000 acre-feet of water supply storage after

sedimentation). At present approximately 82 percent of this storage is being used to service the Kansas River Assurance District No. 1. The Water Assurance District serves communities along the entire length of the Kansas River from Junction City to Kansas City.

Under provisions of our contract with the Water Assurance District, the Kansas Water Office in cooperation with the Corps of Engineers operates the state owned storage in Milford, Tuttle Creek and Perry lakes. Because of its location and high yield potential, Tuttle Creek Lake is the most vital part of this assurance system. The water quality pool at Tuttle Creek Lake serves a critical need of supporting target flows on the Kansas River at Topeka and DeSoto. These target flows insure that the quality of the water that is available in the river is acceptable and that any water that is released for consumption from water supply storage meets its intended purpose.

The Kansas Water Office support maintaining Tuttle Creek Lake at its present level both during construction and for the long term. Any reduction in storage would have a devastating affect on our ability to meet our customer needs. Further, a reduction in lake level would require more water to be used from Milford and Perry lakes causing loss of recreational opportunities and associated economic benefit.

At the time that Tuttle Creek Dam was being designed and constructed, the Corps of Engineers was aware of the possibility of earthquake activity in the region and the fact that the material serving as a foundation for the dam would be sand. In contracting for storage it was our understanding that we were purchasing reliable service from a dam that was built on sound engineering practices.

Under each of the three contracts, the Kansas Water Office agreed to pay for maintenance that would be expected during normal operation. Likewise, we agreed to pay for rehabilitation with the expectation that such rehabilitation would be the result of natural activities of and by operation of the lake. The 1993 flood is such an event, and the Kansas Water Office paid our share of that cost.

Reconstruction of Tuttle Creek Lake due to a change in regulations by the Corps of Engineers does not constitute normal maintenance or rehabilitation necessary because of natural activities or and by operation of the lake. This project results due to the fact that the Corps of Engineers did not adequately take into consideration the effect of earthquakes during initial design. The Kansas Water Office does not think that it is appropriate to pass along a portion of the cost of this design flaw correction to the State of Kansas.

I want to again thank you for the opportunity to comment on this project. Should you have any questions, please feel free to either call me or Earl Lewis.

Al LeDoux, Director, Kansas Water Office by Letter

R: Comment noted. The Corps of Engineers will continue to coordinate with the Kansas Water Office throughout the life of this project. The concerns of the Kansas Water Office as well as those of the Kansas River Water Assurance District No. 1 will be forwarded for further consideration as they relate to contractual requirements.

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C: The Kansas River Water Assurance District No. 1, (KRWAD) makes the following comment regarding the proposed mitigation project at Tuttle Creek Reservoir. KRWAD is a special corporation organized and incorporated pursuant to legislative authority for the express purpose of providing drought assurance to municipalities and industries along the Kansas River. Membership in the district includes the major cities of Junction City, Manhattan, Topeka, Lawrence, Bonner Springs, Olathe and Johnson County Water District No. 1. The major industries include Western Resources, UCB Film, Hills Pet Products, and Kansas City Kansas Board of Public Utilities (Electric). Pursuant to its legislative and corporate authority KRWAD contracted with the State of Kansas for water supply storage capacity in Milford, Tuttle Creek and Perry Reservoirs from which the State of Kansas and the Corps of Engineers are obligated to provide drought releases to the extent water is held in storage for that purpose pursuant to the various agreements. The Corps of Engineers understood in the early 1950s at each stage of dam site selection, planning and construction process the Tuttle Creek dam site was affected by a seismic fault line. At that time it was determined by the federal government that the design and construction of the dam constituted either no threat or acceptable threat to the public. Accordingly, the project was completed, water was stored and ultimately the State and KRWAD entered into drought assurance storage agreements. In the early 1990s storage contracts were negotiated by the State of Kansas and KRWAD. At that time, the Corps of Engineers represented, by their inducement contained in a certain Memorandum of Understanding between the Corps and the State of Kansas (MOU), that Tuttle Creek had certain reliable storage and delivery features that are now being abrogated by the proposed project. Pursuant to the MOU the State of Kansas and KRWAD were led to believe they could purchase the storage capacity for the original construction cost. The proposed remediation plan, through the guise of calling a major reconstruction of the dam a maintenance project, has masked the true capital nature of the expenditure. The finding by the Corps that the site now constitutes a threat to the public safety is not based on any new information but rather a redefining of the old information. This has the effect of passing onto approximately 1.5 million people in the State of Kansas the cost of an upgrade that should have been contemplated by planners in the 1950s. Or, alternatively should be an expense shared by all those who benefit therefrom. The benefits to Tuttle Creek operations, and the proposed project, extend far beyond the boundaries of the State of Kansas. We acknowledge the assignment of benefits to western area power producing states. However, historically the Corps Missouri River Operations Manual extended Tuttle Creek flood benefits to the southeast through the States of Missouri, Illinois, Kentucky, Tennessee, Mississippi and Louisiana. The operation manual also extended recreation benefits to Iowa, Nebraska, South Dakota and North

Dakota by making releases from Tuttle Creek rather than the upper Missouri basin reservoirs. Residents of all those states and untold others enjoy the flood, recreational, navigation and commercial benefits as a result of this operation. Yet, the State of Kansas has been targeted for a significant contribution to the project while other beneficiaries are given a free ride. For the reasons stated in this letter, the KRWAD objects to the Corps passing on the costs of the seismic remediation project to the State and thence to the KRWAD in the amounts proposed by the study. This is a capital improvement and investment project dressed up to look like a maintenance project to make it more palatable to Congress. Larry D. Shannon, President, KIRWAD No. 1 by letter.

R: Comment noted. Specific Congressional approval of Dam Safety Assurance Program projects is not required. The concerns of the Kansas River Water Assurance District No. 1 along with those of the Kansas Water Office will be forwarded for further consideration as they relate to contractual requirements.

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C: I do not support the preferred alternative. It is a lot of tax dollars spend for a maybe fix for a big maybe occurrence. Again poor usage of the tax payers dollars. Gary Henton, Vice Chair, Riley County/Manhattan PROJECT IMPACT Steering Committee Project Impact Survey response by E-mail.

R: Comment Noted

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C: In my estimation \$195 million is not worth having a lake only 5 miles from town. Milford Reservoir and Council Grove Reservoir are each only 30-45 minutes away. Jeff Hancock, Project Impact Survey Response by E-mail.

R: Comment Noted.

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C: \$100 million is a lot of money to spend on something that is such a low risk. I can think of a lot of ways we could use that money in the community. But, considering that is not an option, I think the Corp selected the best option. I would anticipate that there would be some economic benefits in the community associated with the project. Perhaps that will compensate for what is lost in terms of access into the park during the construction phase. Mark Taussig, Project Impact Survey response by E-mail.

R: Comment Noted.

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C: With the national move toward security, what are the odds of obtaining funding for this project? Jenny Hale, K-State Athletics, Verbal Comment at 02 May 2002 Community Meeting.

R: Within the Kansas City District, the Tuttle Creek Dam Safety Project has been and is of the highest priority. This project has received constant support from both the Division Office in Portland and Corps Headquarters in Washington, D.C. However, given the size of this project, it is impossible to state odds for obtaining funding. We have a commitment from Corps Headquarters that funding to begin the project will be available to start the Dam Safety work in Fiscal Year 2003. Funding for security issues is also expected in the near future although the funding would be completely separate.

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ALTERNATIVES

C: The warning system seem unnecessary to us. If there is enough of an earthquake to collapse the dam, the public will know. Project Impact Survey response by mail.

R: The intent of the warning system is to provide information that not only has an earthquake occurred but that the dam has been damaged and evacuation is necessary. An earthquake that can be felt is not necessarily large enough to damage the dam.

C: Because of the very limited seismic risk, I believe that the “preferred alternative” disrupts the community far too much to implement. Mitigating the risk is not worth the significant impacts during construction and the long term changes in the River Pond area. A warning system may be worth considering. Comment card by mail.

R: Comment Noted. A warning system is included in the preferred alternative and measures to offset impacts to the River Pond have been agreed to with the Kansas Department of Wildlife and Parks.

C: We are sending you this letter to give our opinion about the proposal for the Non-draw down of the water level on Tuttle Creek Lake for the earthquake repairs. Since the proposal calls for the lake water level to be managed the same way it is now, we feel that the impact to Big Dawg Marina will be very small. At the beginning we feel some people will not come to the lake. But then after awhile they will come back and use the lake, if nothing has happened out of the ordinary during the construction time. What we would like to see happen during this time of dam repair are two things. One, RV campsites in the Spillway State Park. These will have to be permanent and total at least 30 campsites. Two construct a major rock and earth water break at the mouth of our cove in the Spillway Marina Cove. We were hoping that withy all the earth and rock being moved on both sides of the dam, during this seven to ten year work, that this material could be used for this much needed purpose. With this water break, our Marina could expand and service more of the public. More people would use the lake and the land facilities and the U.S. Corps of Eng., KSDW&P, and Big Dawg Marina would be rewarded. Keith Eyestone, Owner, Big Dawg Marina by letter.

R: The Corps of Engineers and the Kansas Department of Wildlife and Parks have developed a set of measures to offset impacts to the downstream River Pond State Park. These measures do not include additional camping facilities in Spillway State Park. We do not anticipate the project creating the type of material that would be appropriate for the construction of a breakwater for the marina. However, we will keep the request in mind if the opportunity to create a breakwater from waste material is found to be appropriate and economical.

6271

C: Seems you have really done your homework. I like your plan including the wall on top of the dam. We farm in the valley in the Wamego area. Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted

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C: Does the concrete have steel it? Comment Card at 02 May 2002 Community Meeting.

R: The cement treated soil beneath the dam would not have reinforcing steel in it.

6273

C: This is in response to your item in the May 1, 2002 Manhattan Mercury. In a word, No. Before I deal with your questions 1 through 4, let's back up a minute. From the lead paragraph, "The U. S. Army Corps of Engineers (Corps) has determined that an earthquake would cause significant damage to Tuttle Creek Dam." Everyone seems to ignore and accept that statement at face value. We need to see research and proof of that statement. What is the probability of an earthquake of sufficient magnitude? How was that determined? Mr. Seaton's article in the same newspaper states a Corps official as saying the probability was too small to assign a percentage. The Corps also seems to believe that given the earthquake, it would naturally follow that the dam would fail. How did they make that leap of logic? Also, I am surprised to learn that some of the spillway gates did not work in 1993. I visited the area many times during that flood. All the gates seemed to work fine at that time. Was something covered up? In response to your questions: 1. The preferred alternative (That's Corps-speak for we have already decided what to do), does not meet the needs of the community, short or long term. The community needs a better lake in terms of access, water quality, services, stable levels and fishery improvements. Raise the conservation pool level from 1075 feet to 1078 feet and do a better job of keeping it there. Did anyone ever look at Milford Lake and assess how much it fluctuates from conservation pool as compared to Tuttle Creek? It appears that Tuttle Creek is sacrificed, in terms of extreme fluctuating water levels, to maintain Milford at a more stable level. Improved stability at Tuttle Creek would go a long way to improve the water quality and clarity, and to improve the fishery. I do not accept the standard Corps response that there are no dams upstream of Tuttle to control the inflow as there are at Milford Lake. Someone should look at the comparison between the lakes. 2. The preferred alternative will disrupt use of the lake, above and below the dam for several years. The wall across the top of the dam may reduce wave action. But, if the water gets that high those little concrete blocks will go the way of most of the spillway rocks in 1993. As Mr. Seaton points out, they will destroy the view of the lake from the dam. I don't agree with putting the same blocks on the downstream side of the road, the River Pond area and the River valley itself are also worthy of sightseeing from the dam. After the Corps project is completed, there is absolutely nothing to show for all the money, effort and time. There is no obvious and valuable benefit. 3. Other

alternatives have not been adequately addressed. We need the dam and the lake to protect Manhattan and downstream areas from flooding. Building a new dam is a possibility. Has anyone estimated the cost of a new dam? How about a new dam upstream just south of the Randolph bridge? That helps solve the fluctuating water level problem and the siltation problem at the same time. Or maybe two dams, one on Fancy Creek and one on the Big Blue river above Randolph. 4. I do not support the "preferred alternative". I assume the above will explain why. This entire project seems to me another effort of the Corps to justify their existence. Finally, I must assert that Corps officials are fine people for the most part. They do their jobs, as they perceive them, to the best of their abilities. Preservation and justification of the Corps should not be their major goal. Gerold I Holden in Response to Project Impact Survey by E-mail.

R: The earthquake potential of the Manhattan area is well documented. Consultation from international experts regarding the earthquake potential of the Manhattan area was enlisted to ensure accurate characterization of the seismology of the area. These studies are extensively documented in available reports prepared prior to and separate from the Evaluation Report/Environmental Impact Statement process. The findings of investigations and evaluations performed to determine that the dam would be severely damaged are also contained in those reports. Additionally, the Kansas Geological Survey has gone on record before the Kansas State Special Committee on Energy, Natural Resources, and the Environment that the potential for these large earthquakes does exist.

Mr. Seaton's article refers specifically to flooding issues and the comment about probabilities too small to assign a percentage were related to those issues and has nothing to do with earthquake issues.

All of the gates worked as designed in 1993.

1. We have actively and aggressively sought community input and made many changes to the proposed plan and documents as a result of that input.

Changes to lake level management plans would not address seismic concerns.

Comparison of lake level fluctuations at Tuttle Creek and Milford are due to the characteristics of the drainage basins and lakes. Milford has eight dams on the rivers that flow into it that assist in management of inflows. Tuttle Creek does not have any major dams in the lakes drainage basin.

2. Disruption of the use of the lake is not anticipated since lake level management will remain unchanged.

The wave barrier on the top of the dam will be anchored to prevent movement when it is serving its design purpose.

The exact configuration of the crest wave protection will be developed during detailed design to avoid blocking the view from the Highway 13.

The intended obvious and valuable benefit from the proposed alternative is the continued safe operation of Tuttle Creek Dam under all potential conditions.

3. The alternative of replacing the dam is specifically discussed in detail in the documents.

4. Comments noted.

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C: Responses to your questions 1. The preferred alternative does not answer the short-term OR long-term needs of the community; it addresses the immediate needs of the Corps of Engineers to find projects that will necessitate congressional funding rather than budget cuts. The examples provided in the executive summary suggest damage caused by a 6.6 or 5.7 magnitude earthquake. But the report indicates that the dam is only required to meet damages caused by a 4.9 magnitude quake. What are the damages in that instance? And why is it only NOW that the Corps is concerned about earthquake damage -- why was the dam built near a fault in the first place?! See first paragraph for my opinion.... The likelihood of a 5.7 earthquake is once every 1800 years. The dam is silting in so quickly that its useful life will most likely expire well before that time. The question is: is it in the interests of Manhattan (and the American people) to pay nearly \$200 million dollars for a highly unlikely event? If Manhattanites were looking at this question for a community in Oklahoma or Virginia, would they think such spending was important? I think not. 2. Aside from the ridiculous amount of money to do something unnecessary, it very well could affect recreational opportunities, the Country Stampede, travel around the dam and some businesses in the area. In addition, (and I admit I have not read the environmental impact statement yet) where will they be getting the materials to do the fill and stabilization, and how much habitat will be destroyed getting the materials to the sites to do the work? 3. Well, my preferred alternative is to do nothing. My second alternative is to evaluate the needs of the dam in the event of a 4.9 earthquake and see what is necessary for a fix in that situation. I would also suggest factoring the expected life of the dam and lake into the equation for a cost/benefit analysis. In other words, I believe that the Corps has set up a straw target, then devised an expensive way of knocking it down. 4. I think I've already answered this one. I believe that the public should not be threatened by public works, but I also believe that the public cannot be protected 100% without senseless cost. I would like to see a warning system put in place in case of a dam breach, but I don't think this \$200 million project is anything more than makework for an agency facing some downsizing. Everywhere the Corps turns these days, the public is saying whoa, we don't need that kind of mega-project. The agency is, in fact, being ordered to undo some of its earlier works because the original systems of wetlands and unoccupied floodplains functioned a lot better than the dams and levees of the Corps. Like any bureaucracy, the Corps wants to stay in power,

and this is one project that would help it do so. Please, go to our congressional delegation and get this thing stopped. Let's take sensible precautions for a possible occurrence, but let's not take out an anthill with a bulldozer. Jan Garton in response to Project Impact Survey by E-mail.

R: 1. The dam is required to withstand a 6.6 earthquake without significant damage. The dam is required to withstand a 4.9 earthquake with no damage. A 5.7 earthquake will cause significant damage.

The Dam Safety Assurance Program is a national Corps of Engineers program, which is underway specifically to evaluate the earthquake and extreme flood performance of existing dams. Dams in areas of potential seismic activity all over the country are routinely re-evaluated. The potential for large earthquakes in the area was known at the time the dam was built and the intake tower and outlet works were designed to withstand those forces. In the 1940's and 1950's when the dam was designed, it was believed that well built earth structures were not subject to earthquake damage. The near failure of a dam in an earthquake in 1972 led to a new understanding of earthquake damage to dams and has led to the evaluation of many dams worldwide.

2. As documented in the final report, we have reached an agreement with the Kansas Department of Wildlife and Parks to offset the impacts of this project on the surrounding area.

3. Comments noted.

4. A warning system is a proposed component of the preferred alternative.

Comments noted.

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C: No other alternative better addresses community needs. Daniel Bartholomew response to Project Impact Survey by E-mail.

R: Comment Noted

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C: An alternative that would better address community needs would be to make the dam an open bridge and control the flow down stream. Response to Project Impact Survey by mail.

R: Comment Noted. The alternative that is mentioned is the "Remove the Dam" alternative that was considered in the document.

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C: I support the preferred alternative. I think the government should take actions necessary to minimize the risk to personnel and property that is downstream of Tuttle Dam. Daniel Bartholomew response to Project Impact Survey by E-mail.

R: Comment Noted

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C: No other alternative better addresses community needs. It seems to me that this is best. Debora L. Madsen response to Project Impact Survey by mail.

R: Comment Noted

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C: I support the preferred alternative. It strengthens the dam to enhance safety! Debora L. Madsen response to Project Impact Survey by mail.

R: Comment Noted

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C: I like the plan to install a dam failure alarm system, coordinated with local authorities. Debora L. Madsen response to Project Impact Survey by mail.

R: Comment Noted

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C; The preferred alternative addresses the needs of the community very well. The safety of the community has been addressed without too much interruption of the lake and activities associated with the lake. In the short term, there may be some disruption, but the long term will mean a much safer environment. Bob Stamey, Board Member, Riley County Chapter, American Red Cross, Project Impact Survey response by E-mail.

R: Comment Noted

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C: The preferred alternative will have the negative impacts on the community of a repeat of the last flood disaster as compared to the remote chance of an earthquake. Response to Project Impact Survey by mail.

R: Comment Noted

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C: Yes, the preferred alternative will have negative impacts on the community. Obviously the construction and redirected traffic will have a negative impact on the River Pond Campsites. Daniel Bartholomew response to Project Impact Survey by E-mail.

R: Comment Noted. Measures to offset the impacts to the River Pond have been agreed to with the Kansas Department of Wildlife and Parks and included in the final document.

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C: The preferred alternative will have negative impacts on the community only in the short term during construction. (I see the failure to see the dam as you drive across as a frivolous issue). Debora L. Madsen response to Project Impact Survey by mail.

R: Comment Noted

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C: I think it (the preferred alternative) is the best compromise - - interfering as little as possible with wildlife and recreation while providing safety for the downstream people/property. Debora L. Madsen response to Project Impact Survey by mail.

R: Comment Noted

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C: The dam has outlived its use. It worries about 1 business and a few boaters and not the farm land above stream, Roads washed out and another disaster like the last flood. Response to Project Impact Survey by mail.

R: Comment Noted

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C: Instead of the preferred alternative, develop an early warning system and evacuation plan. Gary Henton, Vice Chair, Riley County/Manhattan PROJECT IMPACT Steering Committee Project Impact Survey response by E-mail.

R: A warning system and evacuation plan are included as a portion of the preferred alternative.

6291

C: Why do we have a survey when the Corp has already decided what they will do or at least that it is what is reported in the papers... Gary Henton, Vice Chair, Riley County/Manhattan PROJECT IMPACT Steering Committee Project Impact Survey response by E-mail.

R: The survey in question was developed and implemented by Manhattan/Riley County Project Impact in order to provide another means representation of the community to the Corps of Engineers. The Corps of Engineers was not involved in the development or implementation of this survey. However, as during the Scoping process in the spring of 2001, all input received by Project Impact was incorporated into the final documents that were developed. This input was critical to the development of the preferred alternative. The Corps of Engineers did not make final decisions on any issues until all comments had been received and carefully considered. In fact, several modifications to the reports and preferred alternative were made as a direct result of community input. The largest and most obvious example was the elimination of lake drawdown from the preferred alternative.

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C: The community was given several good opportunities to have input and to ask questions. The alternative taken is the best option. Bob Stamey, Board Member, Riley County Chapter, American Red Cross, Project Impact Survey response by E-mail.

R: Comment Noted

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C: Sure do (support the preferred alternative. Bob Stamey, Board Member, Riley County Chapter, American Red Cross, Project Impact Survey response by E-mail.

R: Comment Noted

6297

C: No (There are no other alternatives that better address community needs). Jeff Hancock, Project Impact Survey Response by E-mail.

R: Comment Noted

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C: I think you should drain the dam and hold back only excess water until it can be released without flooding downstream. When it was built it was supposed to be a thirty year dam. That time has past and the lake is badly silted-in. Doug Regester, Project Impact Survey Response by E-mail.

R: Comment noted. Tuttle Creek Dam was designed with an ECONOMIC life of 100 years meaning that the costs of building and operating the project were only compared to benefits to be gained from the project for 100 years. In general, it is believed that earth embankment dams like Tuttle Creek Dam can remain in operation for well in excess of one hundred years

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C: No (I do not support the preferred alternative). My preference is that we ignore the problem. The lake has been fine for more than 50 years. The actual design life of the lake is only around 100 years from the date of construction. So the lake is half dead. As many already know the lake is silting at a high rate compromising its ability to store water and decreasing its useful life. I can't justify in my mind spending almost \$4 million per year for the next 50 years to fix the problem and then having nothing to show for it when the lake's use (as recreation) is non existent at the end of its design life. Jeff Hancock, Project Impact Survey Response by E-mail.

R: Comment noted.

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C: (The preferred alternative) should protect -add to the economy, etc. Olivia Huddleston for Flint Hills Trail Association, Kansas Trails Council, Inc., Project Impact Response by E-mail

R: Comment Noted

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C: Not that I am aware of (other alternatives that better address community needs), but this is not my area of expertise. Eric Ward, Chief, Blue Township Fire-Rescue, Project Impact Survey response by E-mail.

R: Comment Noted

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C: Don't take a poll, just do it. Frank Gibbs, Project Impact Survey response by E-mail.

R: Comment Noted

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C: Better to be safe than sorry, don't waste the opportunity. Frank Gibbs, Project Impact Survey response by E-mail.

R: Comment Noted

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C: This is the best one (alternative). Olivia Huddleston for Flint Hills Trail Association, Kansas Trails Council, Inc., Project Impact Response by E-mail

R: Comment Noted

6306

C: Of the options, this alternative is the least disruptive, except compared to the "do nothing" option. It should provide some comfort and perhaps help the property values of the property in the flood zone of the dam. In the long term it will all be forgotten. Mark Taussig, Project Impact Survey response by E-mail.

R: Comment Noted

6307

C: I wonder if it would be possible to construct a bridge down stream from the spillway to provide access to the river pond area from Tuttle Creek Blvd. That would minimize the disruption in the area and could become a permanent access into the Park. Mark Taussig, Project Impact Survey response by E-mail.

R: Coordination with the Kansas Department of Wildlife and Parks has lead to agreements that maintain the current access into the River Pond area from the west.

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C: Other alternatives that better address community needs: None! Ron Dickey response to Project Impact Survey by E-mail.

R: Comment Noted

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Yes! (I support the preferred alternative). Ron Dickey response to Project Impact Survey by E-mail.

R: Comment Noted

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C: I could support the preferred alternative assuming it offers long-term protectiveness and permanence. Response to Project Impact Survey by E-mail.

R: Comment Noted. The preferred alternative offers long-term protectiveness and permanence.

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C: No (Are there other alternatives that better address community needs) Ken Hays, Project Impact Survey response by E-mail.

R: Comment Noted

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C: I believe, of the options they have outlined this does the best job of fulfilling the problem. Ken Hays, Project Impact Survey response by E-mail.

R: Comment Noted

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C: I support the preferred alternative due to it's having the least negative impact on environmental and lake use factors. Ken Hays, Project Impact Survey response by E-mail.

R: Comment Noted

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C: I am replying by saying that I have no comments as a Project Impact partner due to our involvement in this project being surveyed and do not in any way influence the survey development nor outcome. Brian McNulty, Project Impact Survey Response by E-mail.

R: Comment Noted

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C: I think that if something has to be done, this is probably the best alternative. It has the least negative impact on the overall community in the short term. Long-term, i.e. over 50 years, the issue may be moot since the dam may have reached it's useful life. Monty Wedel, Project Impact Survey response by E-mail.

R: Comment Noted

6322

C: I haven't seen any alternatives that balance cost, community impact and environmental impact and better than this one. Monty Wedel, Project Impact Survey response by E-mail.

R: Comment Noted

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C: If it is a foregone conclusion that something has to be done, I would support this alternative over the others considered. Monty Wedel, Project Impact Survey response by E-mail.

R: Comment Noted. The "No Action" and "Restricted Lake Operation" alternatives were carried forward as "no build" alternatives for evaluation.

6324

C: It appears to me that this (the preferred alternative) is a viable option, with the least impact to the community of any of the options that would actually take care of the problem. Eric Ward, Chief, Blue Township Fire-Rescue, Project Impact Survey response by E-mail.

R: Comment Noted

6325

C: If was built for flood control so lets use it for that. Lets not use it like we did in 1993. That did not need to happen. Doug Regester, Project Impact Survey Response by E-mail.

R: The dam and reservoir are proposed to continue to meet the Congressionally authorized purpose of flood control. The operation of the dam and lake during 1993 was in specifically in accordance with the approved Reservoir Regulation manual and downstream flood damages were minimized as compared with what would have occurred without the project in place.

6326

C: Yes (I support the preferred alternative). This seems to be the best without upsetting the economy. Olivia Huddleston for Flint Hills Trail Association, Kansas Trails Council, Inc., Projectd Impact Response by E-mail.

R: Comment Noted

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C: My opinion is that an ounce of prevention beats out pounds of disaster. Short term - puts to rest the imminent flooding possibilities. Long term - the dollar amount seems exorbitant in comparison to the estimated life of the reservoir. Ron Dickey response to Project Impact Survey by E-mail.

R: Comment Noted

6329

C: Do nothing. The likelihood of an earthquake is so low! The money could be much better spent elsewhere. Project Impact Survey response by mail.

R: Comment Noted

6330

C: Not really (Do you support the preferred alternative). It may be the least of the evils but is actually ridiculous. Project Impact Survey response by mail.

R: Comment Noted.

6331

C: What is the impact or potential impact to the dam of the work that the Corps is going to do? Could you potentially cause a failure of the dam with the work? Mike Kerns Verbal Comment at 02 May 2002 Community Meeting.

R: Risk to the safety of the dam will not be created during construction. The proposed work is to be performed in progressive stages such that only a portion of the dam will actively be under construction at any one time. A lake level will be established at which excavations will be backfilled and work will be stopped to minimize risk during very high lake levels. New and existing instruments in and below the dam will be routinely monitored now to ensure that the dam remains safe at all times.

6332

C: Will the jet from the jet grouting process pose any threat during construction? Jenny Hale, K-State Athletics, Verbal Comment at 02 May 2002 Community Meeting.

R: The jet from the jet grouting process will not be a threat since it is only used underground below the dam. The jet will not be used at the ground surface or in open air.

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C: You mentioned this alert system. Is it an audio system. Another boondoggle. Why do you think after 50 years that we need an alarm system downstream when we know that the water is rising, we know that floods are imminent but you still think that we need an alarm system. Sheryl Crow, Verbal Comment at 02 May 2002 Community Meeting.

R: In a strict flood control release, there will be days to months leading up to large releases and there will be adequate warning time before releases are made. The dam failure warning system is not a flood warning system. The warning system is only applicable to a potential dam failure after an earthquake. The system is intended to assist in the evacuation of downstream residents and is not related to floods or flooding unrelated to an earthquake. The warning system is the first step in protecting the downstream community in the event of an earthquake.

6335

C: Isn't the sand permeable and doesn't water flow through the sand. Have you considered introducing cement upstream and allowing it to all solidify as concrete. Nates Garrett, Verbal Comment at 02 May 2002 Community Meeting.

R: Although there are expensive chemical grouts that will flow through soil before it sets up, cement will not move significantly between sand grains. The proposed jetting procedure is intended to mix the sand and the cement since the cement will not travel on its own.

6336

C: I am interesting in how deep a layer of that sand is below the dam. Wouldn't the full depth of the sand need to be treated? Nates Garrett, Verbal Comment at 02 May 2002 Community Meeting.

R: The depth of material to be treated is about 30 feet thick and includes some of the upper silts and clays as well as the top of the foundation sands. Sand beneath that level does not need to be treated because it has sufficient pressure on it to prevent the sand from liquefying.

6337

C: Are you going to upgrade the tubes? Harold Merts, Verbal Comment at 02 May 2002 Community Meeting.

R: Minor anchoring of equipment will be required. However, the tower and the conduit (the tubes) are anticipated to perform acceptably during and after the design earthquake.

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C: If the columns on the upstream side of the dam, were drilled into bedrock, wouldn't that eliminate water under the dam and eliminate the downstream treatment. Kelly Gibbons, Verbal Comment at 02 May 2002 Community Meeting.

R: A cutoff wall to bedrock on the upstream side of the dam will minimize water flow under the dam but will not remove the water from beneath the dam. Saturated sands can liquefy regardless of whether there is water standing in the sand or flowing through the sand. The cutoff wall does reduce pressures beneath the dam and make the dam less susceptible to damage after small movements caused by an earthquake.

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C: The normal lake level is 1075, how far above that level will the construction be taking place on the upstream side. Tuttle Creek can rise very rapidly overnight. Does that cause a concern with backfilling any construction areas and if a hole were to fill what does that do to the possibility of dam failure? Dave Mills, Verbal Comment at 02 May 2002 Community Meeting.

R: The exact elevation of the working platform will be determined during construction. However, we expect the platform to be between elevation 1080 and 1100. The upstream platform will be constructed by adding soil to the front of the dam. There will not be significant excavation on the upstream face of the dam. If the lake comes up high enough, the equipment would be moved off of the face of the dam to avoid damage.

6341

C: I experienced water in my house in 1993. I am hear to restate the Chamber of Commerce position that the alternative that has the least impact on economics while keeping safety in mind should be chosen. It appears that the Corps has taken the public input from the public input from the previous meeting and the concerns that we had into consideration. The full board of directors has not met to consider if the preferred alternative to determine if it is definitely in sync with the position we have taken but it appears that it is probably consistent with that. As an individual citizen this appears to be the best alternative of those given. Terry Olsen, Chamber of Commerce, Chair of Public Affairs, Verbal Comment at 02 May 2002 Community Meeting.

R: Comment noted.

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C: I live in Northview, I just want to be sure that someone from that area of 5,000 residents speaks to the issue. Having been affected by the flood of 1993 without an earthquake. This alternative provides benefits in the event of an earthquake and provides for the security of the residents downstream. Your proposal does all of the things that we need to have done to assure our homes, future and our property values there. Linda Morse, Verbal Comment at 02 May 2002 Community Meeting.

R: Comment Noted.

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6344 **INSURANCE ISSUES**

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6346 No comments were received on this subject.

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SCHEDULE

C: This project was studied in depth, over a period of several years. Why so long to arrive at the present state of concern? Comment Card at 02 May 2002 Community Meeting.

R: The process of evaluation of the dam for seismic concerns has included field investigations, laboratory testing, computer modeling, and extensive seismology and engineering data gathering and analyses. After all of these efforts lead to the positive conclusion that there are definitely concerns for the seismic stability of Tuttle Creek Dam, we began the community involvement process that leads to the development and implementation of a preferred alternative. It was critical that we be absolutely certain that there are concerns for the dam in the event of an earthquake before we announce to the community that there is an issue.

6349

C: When will work begin? Comment Card at 02 May 2002 Community Meeting.

R: Full-scale construction of the preferred alternative is scheduled for the fall of 2004. Several smaller field tests and investigations will be performed prior to the full-scale start of work.

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C: How Many months will be needed for completion of this project? Norman F. Marstall by Comment Card at 02 May 2002 Community Meeting.

R: Seven to ten years is currently anticipated to be the worst-case condition for the duration of construction. If it is possible to shorten the duration of the work in coordination with the selected contractor, we intend to pursue that possibility.

6351

C: How long will project take? Comment Card at 02 May 2002 Community Meeting.

R: Seven to ten years is currently anticipated to be the worst-case condition for the duration of construction. If it is possible to shorten the duration of the work in coordination with the selected contractor, we intend to pursue that possibility.

6352

C: What is the timetable to make this "Fix"? I've heard 10 years, if so why so long? Comment Card at 02 May 2002 Community Meeting.

R: Many efforts must be undertaken to complete a project such as this. The process proposed for the preferred alternative requires a large number of holes to be drilled through the earth and rock portions of the dam and a large volume of soil will be stabilized beneath the dam. This process can be exceptionally time consuming. Seven to ten years is currently anticipated to be the worst-case condition for the duration of construction. If it is possible to shorten the duration of the work in coordination with the selected contractor, we intend to pursue that possibility.

6353

C: Why will it take 7-10 years to fix? Comment Card at 02 May 2002 Community Meeting.

R: Many efforts must be undertaken to complete a project such as this. The process proposed for the preferred alternative requires a large number of holes to be drilled through the earth and rock portions of the dam and a large volume of soil will be stabilized beneath the dam. This process can be exceptionally time consuming. Seven to ten years is currently anticipated to be the worst-case condition for the duration of construction. If it is possible to shorten the duration of the work in coordination with the selected contractor, we intend to pursue that possibility.

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C: I am a homeowner on the lake and I will be able to watch this process from my house. From the time you start to the time you run over the last rock, how long? Jerry Holden, Verbal Comment at 02 May 2002 Community Meeting.

R: Seven to ten years is currently anticipated to be the worst-case condition for the duration of construction. If it is possible to shorten the duration of the work in coordination with the selected contractor, we intend to pursue that possibility.

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DRAWDOWN

C: Imagine my alarm and dissatisfaction upon learning of this situation AFTER purchasing a home upstream in July of 2001. None of the realtors representing property alluded to this possible negative situation. I definitely support the preferred alternative. NO DRAWDOWN. Dave Baldwin by Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted. We have made every effort to ensure that the community was as informed about the potential project as possible. These efforts have included a scoping meeting in May of 2001 with an attendance of approximately 300. As a result of that meeting, we were asked to provide a specific breakfast presentation to the Manhattan Realty Board on July 10, 2001 to specifically discuss the potential implications of the proposed project on area real estate.

6391

C: Will my dock still float, even without draw down? Comment Card at 02 May 2002 Community Meeting.

R: Lake level management is not proposed to be altered to facilitate this project.

6392

C: Why not lower the lake level while doing repairs? 5,000 residents will be venerable if there are problems during repair? Comment Card at 02 May 2002 Community Meeting.

R: The evaluation of whether to lower the lake considered all factors including environmental impacts, construction impacts, and downstream risk. The lake level modeling showed that, even with the lake lowered 25 feet, 40 percent of the time we would be unable to release water fast enough to avoid downstream flooding and still keep the lake drawn down. Given the extremely high impacts and costs of drawing the lake down and the high percentage of the time that the lake would be above the target level, we determined that reducing the lake level would not provide the necessary protection. To address the risk to the downstream community until construction can be completed, we intend to install a dam failure warning system to assist residents in evacuation of the area in the event of an earthquake and damage to the dam.

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C: Thank you for no drawdown of water! Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted.

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C: We are residents of Oak Canyon and live on the lake. We like the proposal to maintain this lake level during dam improvements. Comment Card at 02 May 2002 Community Meeting.

R: Comment Noted.

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C: I think the proposed alternative is the one that has the best chance of success with least negative impact. In my mind the main concern is to avoid draining or severely drawing down the lake level for an unknown length of time. Daniel Bartholomew response to Project Impact Survey by E-mail.

R: Comment Noted.

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C: If the lake were lowered to the river would the work go faster? Would the lake "clean" itself? Would the river channel open up so that boats could go up river? Comment Card at 02 May 2002 Community Meeting.

R: If the lake were lowered during construction, the upstream work platform would not be underwater an average of about two to four weeks per year that it would be underwater without drawdown of the lake. Therefore, for an assumed 10-year construction period, if the lake were drawn down, the work could be completed five to ten months faster.

The term "clean" itself is interpreted to refer to the flushing of silt from the lake. If the lake were drawn down, it is expected that the existing silt would be redistributed to areas lower in the lake. It would not be expected that any significant volume of the existing silt in the lake would be flushed downstream beyond the dam. Potential changes in the river channel in the upper ends of the lake during drawdown would be difficult to predict.

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C: Relieving dam tension by drawing down the lake during construction makes sense. Frank Gibbs, Project Impact Survey response by E-mail.

R: Comment Noted.

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C: Even though I hunt and fish, I prefer drawing down the lake. Safety is a higher priority than recreation. Frank Gibbs, Project Impact Survey response by E-mail.

R: Comment Noted.

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C: Is there ever a possibility that the proposed process could be changed so that there is a drawdown of the lake? Keith Eyestone, Big Dawg Marina, Verbal Comment at 02 May 2002 Community Meeting.

R: A Record of Decision will be developed that summarizes the preferred alternative presented in the Final Environmental Impact Statement. The Record of Decision, once signed by the Corps of Engineers, governs how the work is to be performed. If major changes to the work are proposed after the Record of Decision is signed, additional community input would be required and formal changes to the documents would be required.

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9. List of Preparers

The following is a table showing the preparers of the FEIS, their area of expertise, and the sections of the FEIS to which they contributed.

NAME	AREA OF EXPERTISE	SECTION(S) or SUBJECT IN FEIS
William B. Empson	Engineer	Study Project Manager
Joe Cothorn*	NEPA	Water Quality/NEPA review
Nick Rocha*	NEPA	Environmental Justice
David Mathews	Engineer	Seismic Analysis
Vlad Perlea	Engineer	Seismic Analysis
Gordon Lance	Hydraulic Engineer/ Hydrologist	Flood Analysis
Sue Gehrt	Environmental Health	Project Sponsor
Joe Topi	Geologist	Water Quality (ground)
Brian McNulty	Operations Project Mgr.	Lake Project Manager
Mary Lucido	Historical/Cultural	Cultural Resources
James Burton	Biology/NEPA	Affected Environment/ Dam Failure Warning System
Homer Lawrence	Economics	Economic Analysis
Jean Musgrave	Economics	Demographics
Pat Miromontez	Cost Estimating	Project Costs
Garland M. Kersh, Jr.	Aquatic Biologist	Water Quality

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NAME	AREA OF EXPERTISE	SECTION(S) or SUBJECT IN FEIS
Ruth Leonard	Chemist	Water Quality
Steve Spaulding	Hydraulic Engineer	Water Resources
Edward Parker	Hydraulic Engineer	Navigation
David Hoover	Biology/NEPA	Environmental

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All preparers are U.S. Army Corps of Engineers – Kansas City District except those noted by * which are U.S. Environmental Protection Agency – Region VII

10. List of Agencies & Organizations/Libraries/Corps' Offices/Website

Agencies & Organizations:

The following is an agency and organization mailing list for the draft and final Evaluation Report/Environmental Impact Statement:

Environmental Protection Agency, Region VII
 Kansas Water Office
 Riley County Emergency Mgmt
 Riley County Fire Department
 Pottawatomie County Commission
 Manhattan Fire Department
 Shawnee County Emergency Mgmt
 Kansas Dept. of Emergency Mgmt
 Kansas Adjutant General Dept
 Kansas Dept. of Agriculture
 City of Manhattan
 City of Belvue
 City of St. Marys
 City of Wamego
 Federal Emergency Management Agency

U.S. Fish and Wildlife Service
 Kansas Dept. of Wildlife and Parks
 Riley Co./Manhattan Project Impact
 Riley Co. EMS/Mercy Hospital
 Jefferson County Sheriff
 Fort Riley
 Shawnee County Sheriff
 Kansas Dept. of Transportation
 Kansas Geological Survey
 Kansas State University
 City of Silverlake
 Douglas County
 City of St. George
 City of Marysville
 Kansas Dept. of Health & Environment

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LIBRARIES

The following is a list of libraries where the Final Evaluation Report/Environmental Impact Statement is available for community review:

Manhattan Public Library
 629 Poyntz Avenue
 Manhattan, KS
 785-776-4741

Hale Library
 Kansas State University
 Manhattan, KS
 785-532-3014

6441		
6442	Wamego Public Library	Topeka & Shawnee County Public Library
6443	408 Elm St.	1515 SW 10 th Avenue
6444	Wamego, KS	Topeka, KS 66604-1374
6445	785-456-9181	785-580-4400

6446		
6447	Lawrence Public Library	Kansas State Library
6448	707 Vermont St.	300 SW 10 th Avenue/Room 343-N
6449	Lawrence, KS 66044-2371	Topeka, KS 66612-1593
6450	785-843-3833	800-432-3919

6451	
6452	Marysville Public Library
6453	1009 Broadway
6454	Marysville, KS
6455	785-562-2491

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6457 **CORPS OF ENGINEERS OFFICES**

6458

6459 The Final Evaluation Report/Environmental Impact Statement will be
 6460 available for community review during normal business hours at the following Corps
 6461 Offices:

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6463	Tuttle Creek Lake Project Office	Rm. 747 – Library*
6464	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers
6465	5020 Tuttle Creek Blvd.	Kansas City District
6466	Manhattan, KS 66502	700 Federal Building
6467	785-539-8511	601 E. 12 th St.
6468		Kansas City, MO 64106
6469		816-983-3421

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6471	Clinton Lake Project Office	Perry Lake Project Office
6472	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers
6473	872 N. 1402 Rd.	10419 Perry Park Dr.
6474	Lawrence, KS 66049	Perry, KS 66073
6475	785-843-7665	785-597-5144

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6477	Milford Lake Project Office
6478	U.S. Army Corps of Engineers
6479	4020 W. Hwy. K-57
6480	Junction City, KS 66441-8382
6481	785-238-5714

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6483 * Visitors to the Federal Building must present current photo identification
 6484 and pass through a security check before entering the building.

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TUTTLE CREEK DAM SAFETY ASSURANCE PROGRAM WEBSITE

The Final Evaluation Report/Environmental Impact Statement will be available for community review on the following website:

<http://www.nwk.usace.army.mil/tcdam>

This site also includes additional information about Tuttle Creek Lake and the Dam Safety Assurance Program.

Comments on the document can be provided via e-mail at:

tcdam.nwk@usace.army.mil

11. GLOSSARY

Berm - a horizontal step or bench in the sloping profile of an embankment dam.

Drawdown - the lowering of water surface level due to release of water from a reservoir.

Embankment dam - dam constructed of excavated natural materials.

Emergency Action Plan - a predetermined plan of action to be taken to reduce the potential for property damage and loss of life in an area affected by a dam break.

Epicenter - the point on the earth's surface directly above the focus of an earthquake.

Failure - the uncontrolled release of water from a dam.

Floodplain - an area adjoining a body of water or natural stream that has been or may be covered by flood water.

Flood routing - the determination of the attenuating effect of storage on a flood passing through a valley, channel, or reservoir.

Foundation of dam - the natural material on which the dam structure is placed.

Freeboard - the vertical distance between a stated water level and the top of the dam.

Grout cutoff - a barrier produced by injecting grout into a vertical zone, usually narrow horizontally, in the foundation to reduce seepage under a dam.

Hydrograph - a graphic representation of discharge, stage, or other hydraulic property with respect to time for a particular point on a stream.

6534 Intensity scale (Modified Mercalli) - an arbitrary scale used to describe the severity
6535 of earthquake-induced shaking at a particular place. The scale is not based on
6536 measurement but on direct observation.
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6538 Lake Regulation Manual - the document that lays out detailed guidelines and
6539 operating procedures by which water is stored and released from a reservoir.
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6541 Liquefaction - Significant loss of strength of a saturated material subjected to shear
6542 stress large enough to cause relative movement of the soil grains into a denser
6543 configuration, under conditions where the pore water cannot readily escape, with
6544 the result that pore pressure increases and effective intergranular pressure
6545 decreases.
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6547 Magnitude (Richter) - a rating of an earthquake independent of the place of
6548 observation. It is calculated from seismographic measurements and it is related to
6549 the total strain energy released.
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6551 MCE (Maximum Credible Earthquake) - the largest earthquake that can be
6552 reasonably expected to occur at a site, based on geologic and seismological
6553 evidence.
6554

6555 Multi-purpose pool – At Tuttle Creek Lake the multi-purpose pool elevation is
6556 1,075.0 feet, mean sea level, this is the normal elevation that the lake is maintained
6557 at
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6559 OBE (Operating Base Earthquake) - the earthquake for which the structure is
6560 designed to remain operational; this is the earthquake that could reasonably be
6561 expected to affect the structure during its operating life.
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6563 Outlet - an opening through which water can be freely discharged from a reservoir.
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6565 Peak flow - the maximum instantaneous discharge that occurs during a flood. It is
6566 coincident with the peak of a flood hydrograph.
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6568 Piping - the progressive development of internal erosion by seepage.
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6570 PMF (Probable Maximum Flood) - a flood that would result from the most severe
6571 combination of critical meteorologic and hydrologic conditions possible in the region.
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6573 Pressure relief well and collector system - the pressure relief well is a vertical well or
6574 borehole, usually downstream of impervious cores and/or cutoffs, designed to
6575 collect and direct seepage through or under a dam to reduce uplift pressure under
6576 or within a dam. The well is designed to prevent piping of the foundation soil. A line
6577 of such wells forms a drainage curtain that generally discharges the collected water
6578 into a collector ditch.
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6580 Reservoir routing - the computation by which the interrelated effects of the inflow
6581 hydrograph, reservoir storage, and discharge from the reservoir are evaluated.

Riprap - a layer of large uncoursed stones, broken rock, or precast blocks placed in random fashion on the upstream slope of an embankment dam as a protection against wave and ice action.

Seepage - the interstitial movement of water that may take place through a dam, its foundation, or its abutments.

Spillway - a structure over or through which flood flows are discharged.

Stilling basin - a basin constructed to dissipate the energy of fast flowing water and to protect the outlet channel bed from erosion.

Tainter gate - a gate with a curved upstream plate and radial arms hinged to piers or other supporting structures.

Toe of dam - the junction of the upstream/downstream face of the dam with the ground surface.

Underseepage - the interstitial movement of water through a foundation.

12. ACRONYMS

ADAS – automated data acquisition system
BBR – Big Blue River
BOR – Bureau of Reclamation
CAR – Draft Coordination Act Report
cfs – cubic feet per second
COE – Corps of Engineers
CPT – Cone Penetrometer Tests
CWA – Clean Water Act
DEIS – Draft Environmental Impact Statement
DEvR – Draft Evaluation Report
EAP – Emergency Action Plan
EIS – Environmental Impact Statement
EPA – U.S. Environmental Protection Agency
EvR – Evaluation Report
ER – Engineering Regulation
ESA – Endangered Species Act

12. ACRONYMS (continued)

FCAR-Final Coordination Act Report
FEIS – Final Environmental Impact Statement
FevR – Final Evaluation Report
GLO – Government Land Office
IDH – Inflow Design Hydrograph
KCD – Kansas City District (Corps)
KDA – Kansas Department of Agriculture
KDHE – Kansas Department of Health and Environment
KDWP – Kansas Department of Wildlife and Parks
KGS – Kansas Geological Survey
KSR – Kansas River
KWO – Kansas Water Office
M - Magnitude
MCE – maximum credible earthquake
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NOA – Notice of Availability
NOI – Notice of Intent
OBE – Operating Base Earthquake
PAR – Population at Risk
PMF – probable maximum flood
ROD – Record of Decision
SPT – Standard Penetration Test
TCDSAP – Tuttle Creek Dam Safety Assurance Program
USACOE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service
USGS – United States Geological Survey

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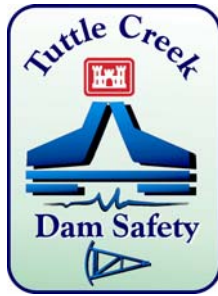
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US Army Corps of Engineers, Kansas City District

TABLES

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***

TABLE 1
SEISMIC REMEDIATION – SUMMARY OF IMPACTS
PAGE 1 of 4

ALTERNATIVES ► ▼ FACTORS	“No Action” Alternative (A. in FEvR)	Restricted Lake Operation (B.4 in FEvR)	Stabilize Foundation Soil With Drawdown (C.2 in FEvR)	Stabilize Foundation Soil Without Drawdown (Preferred Alt., C.2 in FEvR)	Enlarge Embankment (C.3 in FEvR)
POTENTIAL LOSS OF HUMAN LIFE AND PROPERTY SHOULD A MAJOR SEISMIC EVENT OCCUR IN THE PROJECT AREA	There would be loss of human life and property damage resulting from uncontrolled release of the Tuttle Creek pool should a major seismic event occur in the project area.	Under this alternative the potential for loss of human life and property damage resulting from failure of Tuttle Creek dam should a major seismic event occur is less than the “No Action” but greater than the construction alternatives. This is because times when the lake would be above elevation 1,050 ft., m.s.l. for flood control, there would be an increased risk.	This alternative would ensure that there would be no loss of human life and property damage resulting from uncontrolled release of the Tuttle Creek pool should a major seismic event occur in the project area.	This alternative would ensure that there would be no loss of human life and property damage resulting from uncontrolled release of the Tuttle Creek pool should a major seismic event occur in the project area.	This alternative would ensure that there would be no loss of human life and property damage resulting from uncontrolled release of the Tuttle Creek pool should a major seismic event occur in the project area.
CONSISTENT WITH CORPS DAM SAFETY REGULATIONS	This alternative is not consistent with Corps dam safety regulations. This alternative would not minimize the potential for loss of human life and property damage resulting from failure of Tuttle Creek dam should a major seismic event occur. Tuttle Creek Dam would require major repair after a major seismic event in order to maintain the Congressionally authorized project purposes.	This alternative is not consistent with Corps dam safety regulations. The potential for loss of human life and property damage resulting from failure of Tuttle Creek dam should a major seismic event occur is less than the “No Action” but greater than the construction alternatives. This is because times when the lake would be above elevation 1,050 ft., m.s.l. for flood control, there would be an increased risk.	This alternative is consistent with Corps dam safety regulations.	This alternative is consistent with Corps dam safety regulations.	This alternative is consistent with Corps dam safety regulations
WOULD MAINTAIN CONGRESSIONALLY AUTHORIZED PROJECT PURPOSES	<p>This alternative would maintain the Congressionally authorized project purposes.</p> <p>Tuttle Creek Dam would require major repair after a major seismic event in order to maintain the Congressionally authorized project purposes.</p>	<p>This alternative would not maintain the Congressionally authorized project purposes at their existing levels.</p> <p>Tuttle Creek Dam would require major repair after a major seismic event in order to maintain the Congressionally authorized project purposes.</p>	<p>This alternative would maintain the Congressionally authorized project purposes at their existing levels.</p> <p>Even after a major seismic event, Tuttle Creek would be able to maintain the existing level of benefits associated with the Congressionally authorized project purposes.</p>	<p>This alternative would maintain the Congressionally authorized project purposes at their existing levels.</p> <p>Even after a major seismic event, Tuttle Creek would be able to maintain the existing level of benefits associated with the Congressionally authorized project purposes.</p>	<p>This alternative would maintain the Congressionally authorized project purposes at their existing levels.</p> <p>Even after a major seismic event, Tuttle Creek would be able to maintain the existing level of benefits associated with the Congressionally authorized project purposes.</p>
STATUS OF DAM AFTER A MAJOR SEISMIC EVENT	With no modification to the dam or its operation, Tuttle Creek Dam would be seriously damaged by a major seismic event. Slumping of the embankment, cracking of the impervious core and damage to the pressure relief well collector system would result in catastrophic failure of the dam and uncontrolled release of the pool. Embankment and pressure relief well collector system would require major repair to restore normal operations.	With no modification to the dam, the structure would be seriously damaged by a major seismic event. Since the multi-purpose pool elevation would be reduced, damages to the dam and downstream areas associated with uncontrolled release of the smaller pool would be greatly reduced. The dam embankment and collector system would require major repair to restore normal operations.	By stabilizing the foundation soil, Tuttle Creek dam would be expected to survive a major seismic event. There would be no uncontrolled release of the pool or associated damage. Minor repairs to the dam may be required and the pool may be temporarily lowered to inspect the structure after a major earthquake. Dam would be expected to survive and maintain normal operations.	By stabilizing the foundation soil, Tuttle Creek dam would be expected to survive a major seismic event. There would be no uncontrolled release of the pool or associated damage. Minor repairs to the dam may be required and the pool may be temporarily lowered to inspect the structure after a major earthquake. Dam would be expected to survive and maintain normal operations.	By enlarging the embankment, Tuttle Creek dam would be expected to survive a major seismic event. There would be no uncontrolled release of the pool or associated damage. Minor repairs to the dam may be required and the pool may be temporarily lowered to inspect the structure after a major earthquake. Dam would be expected to survive and maintain normal operations.

* DENOTES CONGRESSIONALLY AUTHORIZED PROJECT PURPOSE

TABLE 1
SEISMIC REMEDIATION – SUMMARY OF IMPACTS
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ALTERNATIVES ► ▼ FACTORS	“No Action” Alternative (A. in FEvR)	Restricted Lake Operation (B.4 in FEvR)	Stabilize Foundation Soil with Drawdown (C.2 in FEvR)	Stabilize Foundation Soil Without Drawdown (Preferred Alt., C. in FEvR)	Enlarge Embankment (C.3 in FEvR)
COSTS	No immediate costs to implement. There would be very high costs associated with a seismic related failure of Tuttle Creek Dam. This would include repair of the Tuttle Creek Dam, lost benefits, i.e. flood control, recreation, water supply, fish & wildlife, water quality and navigation, and costs related to downstream flood damages.	Cost would be associated with lost benefits, modification of existing recreation facilities and stabilization of exposed lakebed. There would be very high costs associated with a seismic related failure of Tuttle Creek Dam. This would include repair of the Tuttle Creek Dam and additional lost benefits. Costs related to downstream flood damages & repair of the dam would be expected to be less than the “No Action” alternative due to the smaller pool.	Approximately \$142,900,000 not including mitigation measures. A major seismic event could necessitate minor repairs to the dam. Major cost to repair the dam, or due to loss of benefits, or flood damages would be avoided.	Approximately \$145,900,000 not including mitigation measures. A major seismic event could necessitate minor repairs to the dam. Major cost to repair the dam, or due to loss of benefits, or flood damages would be avoided.	Approximately \$119,800,000 not including mitigation measures A major seismic event could necessitate minor repairs to the dam. Major costs to repair the dam, or due to loss of benefits or flood damages would be avoided.
TIME TO COMPLETE	Represents the current operation. In the unlikely event of a seismic related dam failure, repair of the dam could take several years.	This alternative could be implemented within a short amount of time, i.e. < 5 years, if Congressional authorization could be secured. Stabilization of the newly exposed areas in the lakebed and modification of the existing recreation facilities would comprise the majority of the work.	Construction could begin as early as 2004 if funding is available and would require 7-10 years to complete. Work would proceed year round with upstream and downstream work occurring concurrently.	Construction could begin as early as 2004 if funding is available and would require 7-10 years to complete. Work would proceed year round with upstream and downstream work occurring concurrently.	Construction could begin as early as 2004 if funding is available and would require 7-10 years to complete. Work would proceed year round with upstream and downstream work occurring concurrently.
AESTHETICS	Aesthetics would be unchanged. Population would live with the knowledge that if a major seismic event resulted in dam failure, very severe damage, including potential loss of human life and severe property damage, would occur downstream, especially in Manhattan. In addition, there would be severe damage to the dam and loss of the pool.	For those accustomed to the current lake view, this alternative would result in severe long-term adverse aesthetic impacts. During scoping, residents adjacent to the lake & recreational users expressed strong objection to any long-term alteration of the existing lake view. Much of the area between elevation 1,050 and 1,075 ft., m.s.l. would remain unvegetated as this area would be frequently inundated to maintain flood control.	Greatest adverse aesthetic impacts would be during the 7-10 year construction period when pool is lowered to elevation 1,050 ft., m.s.l. and a great amount of construction equipment/ activity occurs on the dam. Long term, the existing lake view and River Pond State Park would be altered by the work platforms left in place after construction.	Greatest adverse aesthetic impacts would be during the 7-10 year construction period when a great amount of construction equipment/ activity occurs on the dam. Long term, the existing lake view and River Pond State Park would be altered by the work platforms left in place after construction. Since pool would not be lowered, existing lake view would be maintained except for construction activity on face of dam.	Greatest adverse aesthetic impacts would be during construction activity when pool is lowered to elevation 1,050 ft., m.s.l. and a great amount of construction equipment/activity occurs on the dam. Pool would be lowered to elevation 1,050 ft., m.s.l. during 7-10 year construction, disrupting the normal viewscape expected by nearby residents & project visitors. The long-term visual effects of the large berms would probably decrease over time. Visitors to River Pond State Park & Outlet Park would experience the greatest impacts.
THREATENED AND ENDANGERED SPECIES	No effects would be expected to interior least terns or piping plovers. Corps would continue to coordinate with USFWS, KDWP & KWO to ensure that water releases do not adversely affect these listed species. Expect temporary loss of control on flows in the rare event of a seismic related dam failure. No effects would be expected to the bald eagle or the pallid sturgeon.	This alternative is likely to adversely affect the interior least tern and piping plover. The lower lake level required to maintain dam safety, would result in less capacity to hold water to prevent flooding during the nesting season and to make high releases in early summer to encourage birds to utilize highest suitable nesting habitat. Bald eagle may be adversely affected as aquatic habitat is reduced. No effects to the pallid sturgeon. Would require additional consultation with USFWS.	This alternative would have no effect on the interior least tern or piping plover. Pool would be lowered to elevation 1,050 ft., m.s.l. during construction. Existing level of control on releases would be maintained. Bald eagle may be adversely affected as aquatic habitat is reduced as a result of lowering pool during construction. No effects to the pallid sturgeon. Construction activity would have no effect on listed species or their habitat.	This alternative would have no effect on the interior least tern, piping plover, bald eagle or pallid sturgeon. Pool would be operated with the existing multi-purpose pool elevation of 1,075 ft., m.s.l. during construction. Existing level of control on releases would be maintained. Construction activity would have no effect on listed species or their habitat. Corps will coordinate with KDWP and USFWS to ensure campground development has no effect on bald eagle.	This alternative would have no effect on the interior least tern or piping plover. Pool would be lowered to elevation 1,050 ft., m.s.l. during construction. Existing level of control on releases would be maintained. Bald eagle may be adversely affected as aquatic habitat is reduced as a result of lowering pool during construction. No effects to the pallid sturgeon. Construction activity would have no effect on listed species or their habitat.

* DENOTES CONGRESSIONALLY AUTHORIZED PROJECT PURPOSE

TABLE 1
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ALTERNATIVES ► ▼ FACTORS	“No Action” Alternative (A. in FEvR)	Restricted Lake Operation (B.4 in FEvR)	Stabilize Foundation Soil with Drawdown (C.2 in FEvR))	Stabilize Foundation Soil Without Drawdown (Preferred Alt., C.2 in FEvR)	Enlarge Embankment (C.3 in FEvR)
FISH AND WILDLIFE*	No effects would be expected to fish and wildlife resources under this alternative. In the extremely rare event of a seismic related dam failure, fish and wildlife resources associated with the lake, and downstream areas, would be temporarily adversely affected.	Long-term adverse impacts to aquatic organisms would be expected under this alternative as a result of the reduced amount of habitat and the greater fluctuation in pool levels. Terrestrial species would be less affected.	Minor temporary impacts to wildlife resources associated with the construction activity would be expected. More severe impacts to fisheries resources would be expected due to temporary lowering of the pool for 7-10 years. No long-term adverse effects to fish & wildlife resources are expected, even after a major seismic event..	Minor temporary impacts to wildlife resources associated with the construction activity would be expected. Minor adverse impacts to fisheries resources would be expected due to construction of the upstream work platform and loss of trout fishery. No long-term adverse effects to fish & wildlife resources are expected, even after a major seismic event.	Minor temporary impacts to wildlife resources associated with the construction activity would be expected. More severe impacts to fisheries resources would be expected due to temporary lowering of the pool for 7-10 years. No long-term adverse effects to fish and wildlife resources are expected, even after a major seismic event.
RECREATION*	There would be no impacts to recreation under this alternative. In the extremely rare event of a seismic related dam failure, impacts to recreation, especially downstream facilities like River Pond State Park would be very severe. Upstream recreation would be adversely affected until such time as the dam/lake could be restored.	All water based recreation would be adversely affected by this alternative. Recreation facilities would need to be modified or relocated. Even more severe pool fluctuations would be expected. Land based recreation and River Pond State Park and Outlet Park would be unaffected.	River Pond State Park would be severely affected during the 7-10 year construction period. Recreation upstream of the dam would be adversely affected by the lowering of the pool for 7-10 years. After construction, there would be no adverse impacts to recreation and existing operation would resume.	River Pond State Park would be severely affected during the 7-10 year construction period. Recreation upstream of the dam would only be minimally affected since there would be no lake drawdown. After construction, there would be no adverse impacts to recreation and existing operations would resume.	River Pond State Park would be severely impacted during the 7-10 year construction period. In the long-term, area that is currently used for recreation would be covered by the new structure. Recreation upstream of the dam would be minimally affected by construction of the upstream berm.
WATER SUPPLY*	Use of the lake for water supply would be unaffected. In the extremely rare event of a seismic related dam failure, water supply capability would be lost until such time as dam/lake could be restored.	While continuing use of the lake would be possible under this alternative, minor droughts would result in severe drawdowns and associated impacts.	During the 7-10 year construction period, potential use of the lake for water supply would be possible, but minor droughts would result in severe drawdowns and associated impacts. Long term use of the lake for water supply would be unaffected. Even after a major seismic event, the lake would be able to support water supply, after inspection and with expected minimal repairs	During the 7-10 year construction period, potential use of the lake for water supply would not be affected. Long term use of the lake for water supply would be unaffected. Even after a major seismic event, the lake would be able to support water supply, after inspection and with expected minimal repairs	During the 7-10 year construction period, potential use of the lake for water supply would be possible, but minor droughts would result in severe drawdowns and associated impacts. Long term use of the lake for water supply would be unaffected. Even after a major seismic event, the lake would be able to support water supply, after inspection and with expected minimal repairs.
FLOOD CONTROL*	Existing level of flood control would be maintained. After a major seismic event, dam would require extensive repairs in order to carry out existing level of flood control.	Existing level of flood control would be maintained and even slightly enhanced. After a major seismic event, dam would require extensive repairs in order to carry out existing level of flood control	Existing level of flood control would be maintained. Even after a major seismic event, dam would be expected to carry out existing level of flood control, after inspection and with expected minimal repairs.	Existing level of flood control would be maintained. Even after a major seismic event, dam would be expected to carry out existing level of flood control, after inspection and with expected minimal repairs.	Existing level of flood control would be maintained. Even after a major seismic event, dam would be expected to carry out the existing level of flood control, after inspection and with expected minimal repairs.

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TABLE 1
SEISMIC REMEDIATION – SUMMARY OF IMPACTS
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ALTERNATIVES ► ▼ FACTORS	“No Action” Alternative (A. in FEvR)	Restricted Lake Operation (B.4 in FEvR)	Stabilize Foundation Soil with Drawdown (Alternative, C.2 in FEvR)	Stabilize Foundation Soil Without Drawdown (Preferred Alt., C.2 in FEvR)	Enlarge Embankment (C.3 in FEvR)
WATER QUALITY*	Use of the lake to improve downstream water quality would be unaffected. In the extremely rare event of a seismic related dam failure, water quality capability would be lost until such time as dam/lake could be restored.	Long-term, the use of the lake to improve downstream water quality would be severely diminished under this alternative. In the extremely rare event of a seismic related dam failure, water quality capability would be lost until such time as dam/lake could be restored.	During the 7-10 year construction period, the capability of the lake to improve downstream water quality would be severely diminished. Long-term the lake would be able to support downstream water quality at the current level. Even after a major seismic event, the dam would be expected to support downstream water quality, after inspection & any expected minimal repairs.	During the 7-10 year construction period, the capability of the lake to improve downstream water quality would not be diminished. Long-term the lake would be able to support downstream water quality at the current level. Even after a major seismic event, the dam would be expected to support downstream water quality, after inspection & any expected minimal repairs.	During the 7-10 year construction period, capability of the lake to improve downstream water quality would be severely diminished. Long-term the lake would be able to support downstream water quality at the current level. Even after a major seismic event, the dam would be expected to support downstream water quality, after inspection and with expected minimal repairs
NAVIGATION*	Navigation support would not be affected under this alternative. In the extremely rare event of a seismic related dam failure, navigation support would be lost until such time as dam/lake could be restored.	Long-term, the use of the lake to support navigation would be severely diminished under this alternative. In the extremely rare event of a seismic related dam failure, navigation support would be lost until such time as dam/lake could be restored.	During the 7-10 year construction period, the capability of the lake to support navigation would be reduced. Long-term the lake would be able to support navigation at the current level. Even after a major seismic event, dam would be able to support navigation, after inspection and with expected minimal repairs	During the 7-10 year construction period, the capability of the lake to support navigation would not be reduced. Long-term the lake would be able to support navigation at the current level. Even after a major seismic event, dam would be able to support navigation, after inspection and with expected minimal repairs	During the 7-10 year construction period, capability of the lake to support navigation would be reduced. Long-term the lake would be able to support navigation at the current level. Even after a major seismic event, dam would be able to support navigation, after inspection and with expected minimal repairs.
CULTURAL RESOURCES	This alternative would have no effect on any cultural resources sites. Project would continue to be operated in accordance with existing Cultural Resources Plan. If a major seismic event resulted in dam failure, sites below current multipurpose Pool could be exposed to erosion and/or vandalism. Cultural resource sites in the inundated area could be destroyed by scouring flows or exposed to vandalism.	There are 22 archaeological and 3 historic sites between 1,075 and 1,050 ft. m.s.l. Of this total, 15 archaeological and 3 historic sites are believed to be under 3-10 foot of sediment and would not be affected. Remaining sites would be monitored. If a major seismic event resulted in dam failure, sites below elevation 1,050 ft., m.s.l. could be exposed to erosion and/or vandalism. Cultural resource sites in the inundated area could be destroyed by scouring flows or exposed to vandalism.	No direct effects to historic properties from proposed construction activity. There are 22 archaeological and 3 historic sites between 1,075 and 1,050 ft. m.s.l. Of this total, 15 archaeological and 3 historic sites are believed to be under 3-10 foot of sediment and would not be affected. Remaining sites would be monitored during temporary drawdown.	No direct effects to historic properties from proposed construction activity. Since there would be no drawdown, there will be no sites exposed during construction.	No direct effects to historic properties from proposed construction activity. There are 22 archaeological and 3 historic sites between 1,075 and 1,050 ft. m.s.l. Of this total, 15 archaeological and 3 historic sites are believed to be under 3-10 foot of sediment and would not be affected. Remaining sites would be monitored during temporary drawdown.
POTENTIAL MITIGATION MEASURES	No mitigation measures would be proposed or required under the “No Action” Alternative.	Water related recreation facilities adjacent to the lake would require substantial modification as a result of the permanent lowering of the pool to 1,050 ft., m.s.l. The River Pond State Park would not be affected. Mitigation related to drawdown only.	Water related recreation facilities adjacent to the lake would require substantial modification as a result of the temporary lowering of the pool to 1,050 ft., m.s.l. The River Pond State Park would be affected by construction activity. Mitigation related to drawdown and construction activity on the dam.	Water related recreation facilities adjacent to the lake would not require modification. The River Pond State Park would be affected by construction activity. Mitigation related to construction activity on the dam only.	Water related recreation facilities adjacent to the lake would require substantial modification as a result of the temporary lowering of the pool to 1,050 ft., m.s.l. The River Pond State Park would be affected by construction activity. Mitigation related to drawdown and construction activity on the dam..

* DENOTES CONGRESSIONALLY AUTHORIZED PROJECT PURPOSE

Table 2
Compliance of Preferred Alternative with Environmental Protection
Statutes and Other Environmental Requirements

Federal Polices	Compliance
Archeological Resources Protection Act, 16 U.S.C. 470, et seq.	Full Compliance
Clean Air Act, as amended, 42 U.S. C. 7401-7671g, et seq.	Full Compliance
Clean Water Act (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	Full Compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not Applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full Compliance
Estuary Protection Act, 16 U.S.C. 1221, et seq.	Not Applicable
Federal Water Project Recreation Act, 16 U.S.C. 4601-12, et seq.	Full Compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq.	Full Compliance
Land and Water Conservation Fund Act, 16 U.S.C. 4601-4, et seq.	Not Applicable
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not Applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full Compliance
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470a, et seq.	Full Compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full Compliance
Wild and Scenic River Act, 16 U.S.C. 1271, et seq.	Full Compliance
Farmland Protection Policy Act, 7 U.S.C. 4201, et. seq.	Full Compliance
Protection & Enhancement of the Cultural Environment (Executive Order 11593)	Full Compliance
Floodplain Management (Executive Order 11988)	Full Compliance
Protection of Wetlands (Executive Order 11990)	Full Compliance
Environmental Justice (Executive Order 12898)	Full Compliance

NOTES:

- a. Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or postauthorization).
- b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning.
- c. Noncompliance. Violation of a requirement of the statute.
- d. Not applicable. No requirements for the statute required; compliance for the current stage of planning.



US Army Corps of Engineers, Kansas City District

FIGURES

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***



US Army Corps of Engineers, Kansas City District

APPENDICES

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APPENDIX A

Tuttle Creek Dam Safety Assurance Study Website

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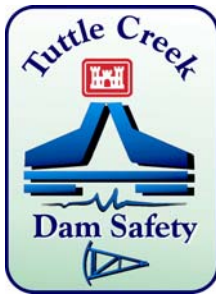
APPENDIX B

U.S. Fish & Wildlife Service Draft Coordination Act Report

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***





US Army Corps of Engineers, Kansas City District

[Redacted]

APPENDIX C

Kansas Department of Wildlife and Parks

Scoping Comment Letter

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***

[Redacted]



US Army Corps of Engineers, Kansas City District

[Redacted]

APPENDIX D

Kansas Department of Wildlife and Parks

**State Listed Threatened and Endangered Species in
Riley and Pottawatomie Counties, Kansas**

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***

[Redacted]



US Army Corps of Engineers, Kansas City District

[Redacted]

APPENDIX E

Common Mammals, Birds, Amphibians, Reptiles and Fish of the Project Area

July 2002

***Tuttle Creek Dam Safety Assurance Program
Final Environmental Impact Statement***

[Redacted]

Appendix E

Common Mammals, Birds, Amphibians, Reptiles and Fish of the Project Area

Mammals commonly found in the project area include:

white-tailed deer (<i>Odocoileus virginianus</i>)	coyote (<i>Canis latrans</i>)
opossum (<i>Didelphis marsupialis</i>)	raccoon (<i>Procyon lotor</i>)
cottontail rabbit (<i>Sylvilagus floridanus</i>)	muskrat (<i>Ondatra zibethica</i>)
beaver (<i>Castor canadense</i>)	badger (<i>Taxidea taxus</i>)
striped skunk (<i>Mephitis mephitis</i>)	fox squirrel (<i>Sciurus niger</i>)
plains pocket gopher (<i>Geomys bursarius</i>)	
short-tailed shrew (<i>Blarina brevicauda</i>)	
thirteen-lined ground squirrel (<i>Spermophilus tridecemlineatus</i>)	
prairie white-footed mouse (<i>Peromyscus maniculatus</i>)	
woodland white-footed mouse (<i>Peromyscus leucopus</i>)	
prairie meadow mouse (<i>Microtus ochrogaster</i>)	
plains harvest mouse (<i>Reithrodontomys montanus</i>)	
western harvest mouse (<i>Reithrodontomys megalotis</i>)	
eastern wood rat (<i>Neotoma floridana</i>)	
meadow jumping mouse (<i>Zapus hudsonius</i>)	
eastern mole (<i>Scalopus aquaticus</i>)	little brown bat (<i>Myotis lucifugus</i>)
silver-haired bat (<i>Lasionycteris noctivagans</i>)	red bat (<i>Lasiurus borealis</i>)
big brown bat (<i>Eptesicus fuscus</i>)	hoary bat (<i>Lasiurus cinereus</i>)

Common resident or migrant birds of the Tuttle Creek Lake project area include:

great blue heron (<i>Ardea herodias</i>)	belted kingfisher (<i>Ceryle alcyon</i>)
green heron (<i>Butorides virescens</i>)	whip-poor-will (<i>Caprimulgus vociferus</i>)
blue-winged teal (<i>Anas discors</i>)	western kingbird (<i>Tyrannus verticalis</i>)
wood duck (<i>Aix sponsa</i>)	horned lark (<i>Cremophila alpestris</i>)
mallard (<i>Anas platyrhynchos</i>)	blue jay (<i>Cyanocitta cristata</i>)
red-tailed hawk (<i>Buteo jamaicensis</i>)	common crow (<i>Corvus brachyrhynchos</i>)
bald eagle (<i>Haliaeetus leucocephalus</i>)	black-eyed chickadee (<i>Parus atricapillus</i>)
peregrine falcon (<i>Falco peregrinus</i>)	tufted titmouse (<i>Parus bicolor</i>)
marsh hawk (<i>Circus cyaneus</i>)	starling (<i>Sturnus vulgaris</i>)
American kestrel (<i>Falco sparverius</i>)	warbling vireo (<i>Vireo gilvus</i>)
turkey vulture (<i>Cathartes aura</i>)	yellow-breasted chat (<i>Decteria virens</i>)
house sparrow (<i>Passer domesticus</i>)	bobwhite quail (<i>Colinus virginianus</i>)
robin (<i>Turdus migratorius</i>)	morning dove (<i>Zenaida macroura</i>)
western meadowlark (<i>Sturnella neglecta</i>)	rock dove (<i>Columba livia</i>)
red-winged blackbird (<i>Agelaius phoeniceus</i>)	American coot (<i>Fulica americana</i>)
common grackle (<i>Quiscalus quiscula</i>)	killdeer (<i>Charadrius vociferus</i>)
Harris sparrow (<i>Zonotrichia querula</i>)	spotted sandpiper (<i>Actitis macularia</i>)
tree sparrow (<i>Spizella arborea</i>)	great horned owl (<i>Bubo virginianus</i>)
chipping sparrow (<i>Spizella passerina</i>)	purple martin (<i>Progne subis</i>)

Appendix E – continued (Birds)

barred owl (*Strix varia*)
screech owl (*Otus asie*)
common night hawk (*Chordeiles minor*)
red-bellied woodpecker (*Centurus carolinus*)
red-headed woodpecker (*Melanerpes erythrocephalus*)
house wren (*Troglodytes aedon*)
eastern wild turkey (*Meleagris gallopovo*)
field sparrow (*Spizella pusilla*)
brown thrasher (*Toxostoma rufum*)

Common reptiles that may be found in the Tuttle Creek Lake include:

snapping turtle (*Chelydra serpentine*)
ornate box turtle (*Terrapene ornata*)
painted turtle (*Chrysemys picta*)
smooth soft-shelled turtles (*Trionyx muticus*)
earless lizard (*Holbrookia sp.*)
spiny soft-shelled turtles (*Trionyx spiniferus*)
collared lizard (*Crotaphytus collaris*)
Texas horned lizard (*Phrynosoma cornutum*)
prairie skink (*Eumeces septentrionalis*)
Great Plains skink (*Eumeces obsoletus*)
six-lined racerunner (*Cnemidophorus sexlineatus*)
glass-snake lizard (*Ophisaurus attenuatus*)
prairie ringnecked snake (*Diadophis punctatus*)
Eastern hog-nosed snake (*Heterodon platyrhinos*)
Western hog-nosed snake (*Heterodon nasicus*)
blue racer (*Coluber constrictor*)
bullsnake (*Pituophis melanoleucus*)
prairie king snake (*Diadophis punctatus arnyi*)
blotched king snake (*Lampropeltis calligaster*)
black-headed tantilla (*Tantilla gracilis*)
common water snake (*Natrix sipedon*)
red-sided garter snake (*Thamnophis sirtalis*)
copperhead (*Agkistrodon contortrix*)
massasauga (*Sistrurus catenatus*)
timber rattlesnake (*Crotalus horridus*)

Common amphibians found in the Tuttle Creek Lake area include:

tiger salamander (*Ambystoma tigrinum*)
bullfrog (*Rana catesbeiana*)
leopard frog (*Rana pipiens*)
plains toad (*Bufo cognatus*)
plains spadefoot toad (*Scaphiopus bombifrons*)
striped chorus frog (*Pseudacris triseriata*)
rocky mountain toad (*Bufo woodhousii*)
plains leopard frog (*Rana blairi*)
northern cricket frog (*Acris crepitans*)

Appendix E – continued

Common fish found in Tuttle Creek Lake, the Kansas and Big Blue Rivers:

gizzard shad (<i>Dorsoma cepedianum</i>)	channel catfish (<i>Ictalurus punctatus</i>)
freshwater drum (<i>Aplodinotus grunniens</i>)	flathead catfish (<i>Pylodictis olivaris</i>)
carp (<i>Cyprinus carpio</i>)	white bass (<i>Morone chrysops</i>)
red shiner (<i>Cyprinella lutrensis</i>)	bluegill (<i>Lepomis macrochirus</i>)
sand shiner (<i>Notropis ludibundus</i>)	white crappie (<i>Pomoxis annularis</i>)
stoneroller (<i>Campostoma anomalum</i>)	black crappie (<i>Pomoxis nigromaculatus</i>)
golden shiner (<i>Notemigonus crysoleucas</i>)	yellow bullhead (<i>Ameiurus natalis</i>)
bigmouth buffalo (<i>Ictiobus cyprinellus</i>)	walleye (<i>Stizostedion vitreum vitreum</i>)
smallmouth buffalo (<i>Ictiobus bubalus</i>)	striped bass (<i>Morone saxatilis</i>)
river carpsucker (<i>Carpionodes carpio</i>)	goldfish (<i>Carassius auratus</i>)
largemouth bass (<i>Micropterus salmoides salmoides</i>)	

rainbow trout (*Oncorhynchus mykiss*) - stocked in the relief well ditch in River Pond State Park below the dam by the Kansas Department of Wildlife and Parks.



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APPENDIX F

Common Trees, Shrubs and Grasses of the Project Area

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Appendix F

Common Trees, Shrubs and Grasses of the Project Area

Predominant tree species found on the project lands include:

American elm (<i>Ulmus americana</i>)	honey locust (<i>Gliditsia triancanthos</i>)
sycamore (<i>Platanus occidentalis</i>)	osage-orange (<i>Maclura pomifera</i>)
black walnut (<i>Juglans nigra</i>)	redbud (<i>Cercis cancdensis</i>)
bur oak (<i>Quercus macrocarpa</i>)	slippery elm (<i>Ulmus rubra</i>)
chinkapin oak (<i>Quercus muehlenbergii</i>)	green ash (<i>Fraxinus pennsylvanica</i>)
eastern cottonwood (<i>Populus deltoides</i>)	mulberry (<i>Morus rubra</i>)
hackberry (<i>Celtis occidentalis</i>)	eastern red cedar (<i>Juniperous virginiana</i>)
hawthorn (<i>Crataegus sp.</i>)	

Deciduous shrubs on the project lands include:

rough leaf dogwood (<i>Cornus drummondii</i>)	smooth sumac (<i>Rhus glabra</i>)
buckbrush (<i>Symphoricarpos orbiculatus</i>)	gooseberry (<i>Ribes missouriense</i>)
elderberry (<i>Sambucus canadensis</i>)	poison ivy (<i>Rhus radicans</i>)
fragrant sumac (<i>Rhus aromatica</i>)	prairie rose (<i>Rosa arkansana</i>)

Grass cover on the project lands include:

big bluestem (<i>Andropogon gerardii</i>)	Kentucky bluegrass (<i>Poa pratensis</i>)
little bluestem (<i>Schizaccharium scoparium</i>)	vervain (<i>Verbena sp.</i>)
indiangrass (<i>Sorghastrum nutans</i>)	windmill grass (<i>Chloris verticillata</i>)
switchgrass (<i>Panicum virgatum</i>)	tall dropseed (<i>Sporobolus asper</i>)
tumblegrass (<i>Schedonnardus paniculatus</i>)	



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[Redacted]

APPENDIX G

Section 404 of the Clean Water Act Compliance Review Documents (Public Notice/Draft 404(b)(1) Evaluation)

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[Redacted]



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APPENDIX H

Cultural Resource Sites at Tuttle Creek Lake

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APPENDIX H – Cultural Resource Sites at Tuttle Creek Lake

ELEV.	SITE NO.	QUAD	STATUS	AGE	APPROXIMATE SEDIMENTATION IN FT.
1040	14PO0021	Olsburg SW	Inundated	Historic	4
1040	14PO0023	Tuttle Creek Dam	Inundated	Prehistoric	3
1040	14RY0010	Tuttle Creek Dam	Recreation - Intensive	Prehistoric	Behind dam - destroyed
1040	14RY0012	Tuttle Creek Dam	Inundated	Prehistoric	3
1040	14RY0013	Olsburg SW	Inundated	Prehistoric	4
1040	14RY0019	Olsburg SW	Inundated	Prehistoric	4
1040	14RY0025	Olsburg SW	Inundated	Prehistoric	6
1040	14RY0026	Olsburg SW	Inundated	Prehistoric	6
1045	14PO0017	Olsburg SW	Inundated	Prehistoric	4
1050	14RY0014	Olsburg SW	Inundated	Prehistoric	6
1050	14PO0018	Olsburg SW	Inundated	Prehistoric	4
1050	14RY0002	Olsburg NW	Inundated	Prehistoric	10 Fancy Creek N of Highway 16 (Randolph) Brdg.
1050	14RY0020	Olsburg SW	Inundated	Prehistoric	4
1060	14RY0011	Tuttle Creek Dam	Inundated	Prehistoric	3
1060	14RY1691	Olsburg SW	Inundated	Historic/Prehistoric	4
1065	14RY0022	Olsburg SW	Inundated	Prehistoric	4
1070	14RY0326	Olsburg NW	Recreation - Intensive	Prehistoric	10 Fancy Creek N of Highway 16 (Randolph) Brdg.
1070	14PO0020	Olsburg SW	Inundated	Prehistoric	4
1070	14RY0334	Olsburg NW	Wildlife Management	Prehistoric	10 Fancy Creek N of of Highway 16 (Randolph) Brdg.
1070	14RY0339	Olsburg NW	Inundated	Prehistoric	6
1075	14RY0344	Olsburg NW	Inundated	Prehistoric	6
1050-1080	14RY0027	Olsburg SW	Recreation - Low Density	Prehistoric	6
1060-1070	14PO0019	Olsburg NW	Inundated	Prehistoric	6
1060-1070	14PO0604	Olsburg SW	Inundated	Prehistoric	4
1060-1070	14RY0016	Olsburg NW	Inundated	Prehistoric	8
1070-1080	14RY0017	Olsburg NW	Recreation - Low Density	Prehistoric	6
1070-1080	14RY0368	Olsburg SW	Rec - Low Density	Prehistoric	6
1070-1100	14RY0335	Olsburg SW	Recreation - Low Density	Prehistoric	4
Below 1075	Randolph		Inundated	Historic	10
Below 1075	Stockdale		Inundated	Historic	4
Below 1075	Garrison		Inundated	Historic	6
No Effect	14PO1		Wildlife Management	Prehistoric	0 N of Highway 16 (Randolph) Brdg.

Highlighted Sites = No further work recommended by past archeological investigations
or Tuttle Creek Historic Properties Management Plan



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APPENDIX I

401 Water Quality Certification

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APPENDIX J

Comments Received in Response to the DEvR/DEIS

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